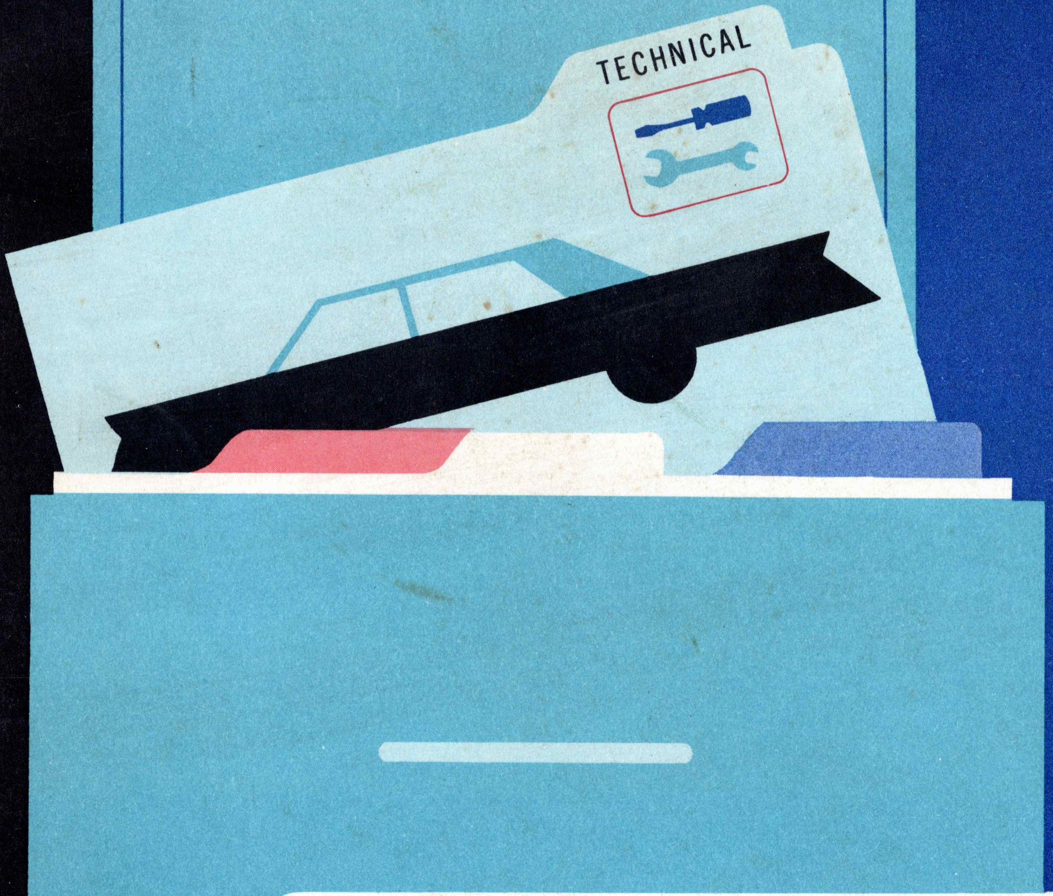
Mobil



Inside information

Mobil
Mobil
Regular
Super

A NOTE TO READERS:

All measurements quoted in this edition of "Inside Information" are in metric units. At the back of this book you will find a metrication conversion table.

1-00

ALLEN DRIVING SCHOOL
94 VICTORIA STREET,
CHRISTCHURCH, 1.
PHONE 79-268

Before you turn the key... know what makes it go!

This book is designed to provide you, the motorist, with a better understanding of your vehicle. It is not a text book, but it does, in simple terms, explain the modern car in a way which will make it interesting to those who already have cars, those contemplating buying a car and those who drive other people's vehicles. We believe a clear grasp of the principles of operation is essential for the motorist to gain maximum efficiency and economy from his car. It is our hope that this book helps you towards that goal . . . along the road to happy motoring.

Mobil Oil New Zealand Limited

Through the assembly line

Here we build, pictorially, and in simple stages (a) a car with a chassis and having the body attached and (b) a car where the body shell is designed and strengthened to take the place of a chassis.

1 *The Chassis*

The chassis is the foundation of the car. Most chassis consist of two steel beams made rigid by cross members. There are some designs which use a single central tube with the body and other components carried on outrigger arms attached to this frame tube.

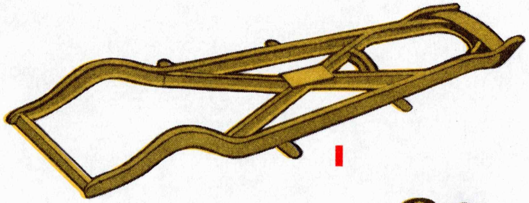
2 *Then the Engine, Clutch and Gear Box are added*

The engine is usually bolted to the chassis at three points and mounted on rubber to minimize vibration. The clutch allows you to connect or disconnect the power of the engine to or from the gear box. The gear box, in turn, contains gears, which assist the driver to control the flow of power to the rear wheels.

3 *Next come the Propeller Shaft, Universals and Rear Axle*

The propeller shaft transmits the power from the gear box to the rear axle, the universals being flexible joints which allow the assembly to flex and yet continue to transmit power smoothly when the car is travelling over uneven surfaces.

The rear axle casing houses the differential, which transmits the power through a right angle to drive the wheels and also allows them to turn at different speeds when rounding corners.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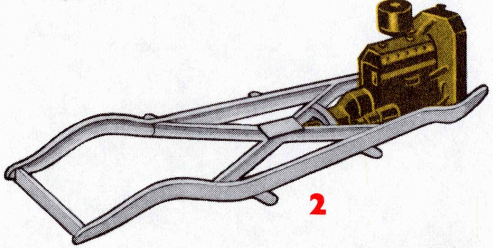
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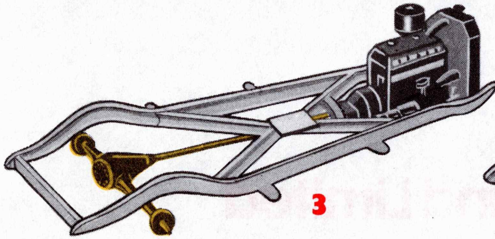
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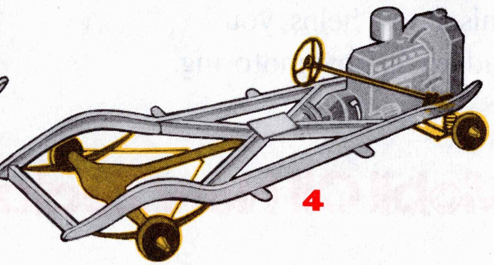
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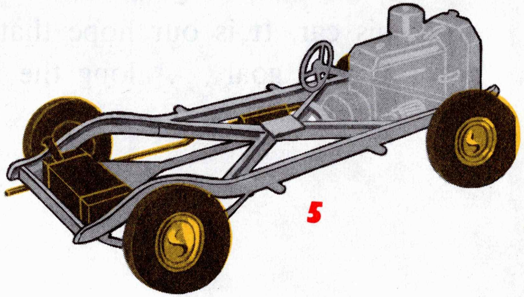
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4 *Now the Front and Rear Suspension systems, Front Axle, Front and Rear Brakes, and Steering Mechanism*

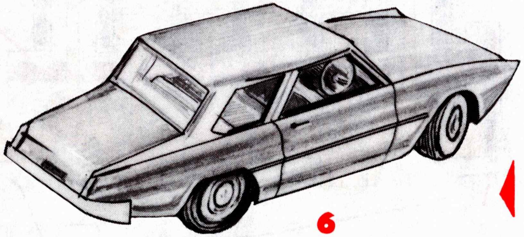
To provide insulation from road shocks for the passenger, and to improve comfort, suspension systems incorporating springs and shock absorbers are used. The front stub-axles, the steering wheel and column, steering box, gear change lever and the necessary linkage are fitted now. The stub-axles carry the front wheels and also pivot to allow the wheels to turn when the steering wheel is turned. The brakes also are added.

5 *To complete the Chassis Assembly*

Wheels and tyres, exhaust and silencing system and petrol tank are now fitted. On some cars the dashboard and instruments are also fitted at this stage.

6 *Final Assembly*

Finally, the body is added and all electrical units — lights, petrol pump, coil, horn, windscreen wipers, and instruments — are wired up. After a check by an inspector and a test run, the car is ready for delivery.



6

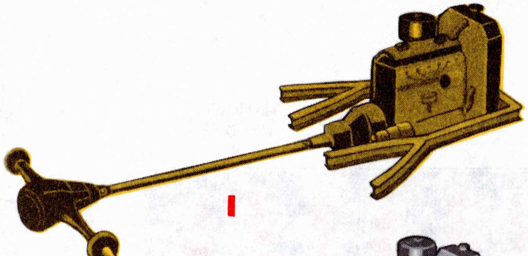
Monoconstruction

1 The engine, gear box and propeller shaft are assembled first.

2 Next the front and rear suspensions and braking systems are added.

3 Followed by the body, which is a complete "shell" and does away with a separate chassis.

4 The interior trim, which includes seats, linings, dashboard, steering wheel, etc. Then the exterior fittings, such as head and tail lights, Bumper bars, etc., follow. Finally the wheels and tyres are fitted, and the car is tested ready for delivery.



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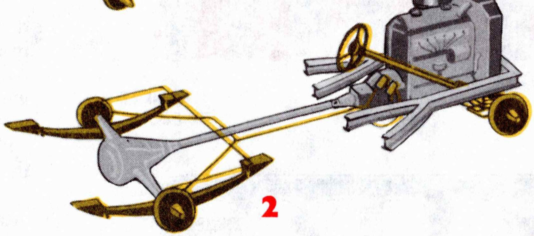

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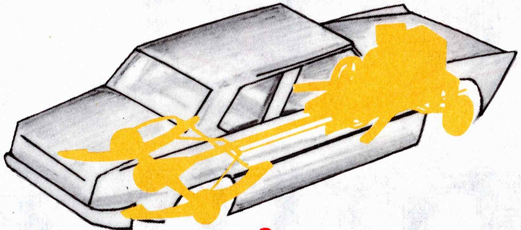
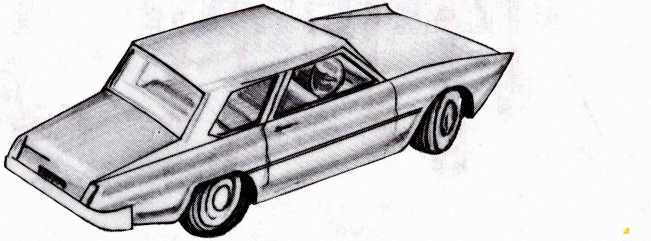


3

◀ **Final assembly** ▶



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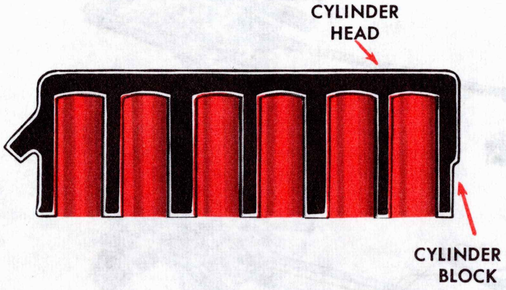
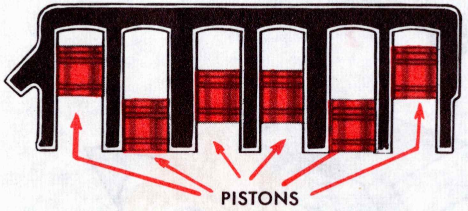
What is an engine?





The engine is made up of a group of cylinders. Two, four, six, eight or twelve in number. A cylinder is simply a cylindrical hole, usually cast in a block of iron, called a cylinder block. There are also hollow channels in the cylinder block, through which water flows, to cool the cylinders. The cylinder is bored for greater accuracy, and sealed at the top, by the cylinder head.

There's only one movable thing in each cylinder. It is called a piston, and it's like a plunger in a bicycle pump. A piston can move only in two ways — up and down within the cylinder in which it travels.

The connecting rod holds the piston in its cylinder, and is rightly termed, for it "connects" the piston to the crankshaft.

At the top of the connecting rod, where it is attached to the piston, there is a mechanical movement similar to the movement of your wrist joint. This is accomplished by means of a "gudgeon pin" or "wrist pin".

At the other end of the rod, where it connects with the crankshaft, there is another bearing, known as a "crank pin" or "big end" bearing.

A crankshaft simply means a shaft which is made up of a number of crank arms forged on one shaft — one crank arm for each cylinder.

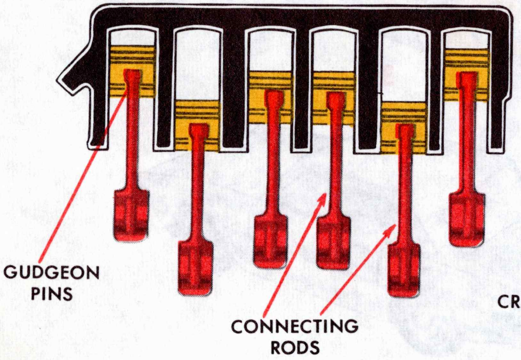
Where the crankshaft fits into the crankcase there are a number of bearings to support it. These are the "crankshaft" or "main" bearings.

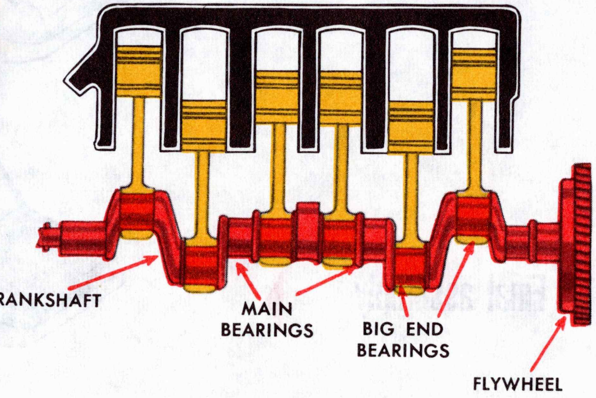
A flywheel is bolted to the rear end of the crankshaft. This helps smooth out the flow of power impulses from the engine.

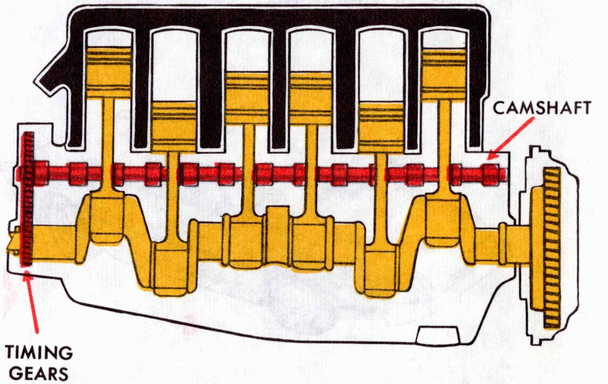
Attached to the other end of the crankshaft is a gear which drives the camshaft gear. These are known as "timing gears", because they "time" the opening and closing of the valves through the camshaft. Some camshafts are driven by a chain from the crankshaft. In this case the gears are replaced by chain sprocket wheels.

The radiator cools the circulating water which carries the heat away from the cylinder walls and cylinder head.

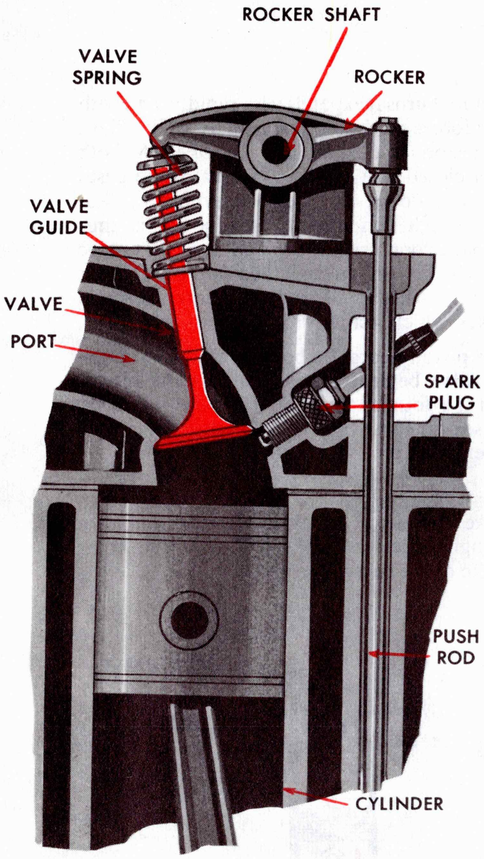
The engine assembly is completed by fitting the fuel and ignition systems, each of which is described in later pages.







Valves are vital



The camshaft is a shaft carrying a number of lobes or cams — usually two for each cylinder — whose function is to lift, at regulated intervals, the mechanism which opens the valves.

For each cylinder there are two tunnels cast in the cylinder head, or — in the case of a side valve engine — in the cylinder block. One is for the passage of the incoming air/petrol mixture to the combustion space between the top of the piston and the cylinder head; and the other for the outgoing exhaust gases after combustion has taken place.

These tunnels terminate in ports or openings facing directly into the cylinder, and are opened and closed by tulip-shaped valves. When these valves are in the closed position, they securely seal the opening into the cylinder head.

The valve stem serves three main purposes :

1. It transmits the movement imparted by the cam, to the valve head, thus opening and closing the port.

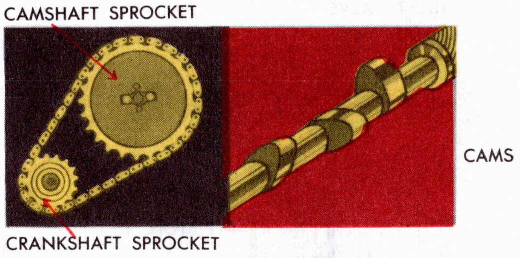
2. It passes through a long bearing called a valve guide, enabling the valve head to rise and fall truly and seat accurately each time.

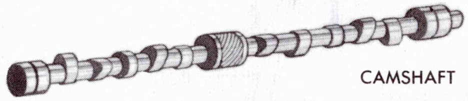
3. It carries heat away from the valve head, and passes it on through the valve guide to the cylinder head.

It would not be practical for the valve stems to make direct contact with the cams as they would quickly wear out. Therefore, cam followers, commonly called tappets, are placed between the valve stems and cams. These are moved up and down by the cams on the camshaft, and can be adjusted to take up wear. On an overhead valve engine, the clearances are obtained by adjusting screws set in the valve rocker arms.

When the valves are closed they are held on their seats by stiff coil springs. Timing gears control the cam movements, which open and close the valves at the right moment.

Each cylinder must have at least two valves. One, called the "inlet" valve, which admits the fuel charge of petrol vapour and air into the cylinder; the other, known as the "exhaust" valve, allows the burned gases to be expelled.





Why it's called a four-stroke engine

The four-stroke engine is so called because it takes four complete strokes of the piston (two down and two up) to complete the one power cycle.

The first stroke of the cycle is the *inlet stroke,* during which the piston travels *down* the cylinder, creating a vacuum in the cylinder as it does so. The outside air pressure being greater than that now in the cylinder, air rushes in, via the carburettor and the inlet valve, to fill the space left empty by the moving piston. The air passing through the carburettor draws the petrol with it, and there is now a highly combustible mixture in the cylinder.

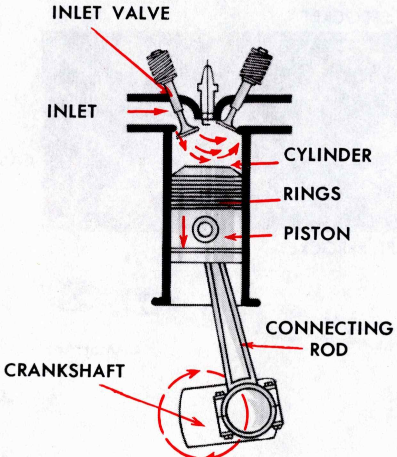
The second stroke or *compression stroke* is named thus because both valves are closed as the piston travels back up the cylinder, and, there being no way for the combustible mixture in the cylinder to escape, it is "squeezed" or compressed between the piston and the cylinder head.

Just before the piston reaches top dead centre, the electrical system causes a spark to occur at the spark plug gap, and this ignites the mixture.

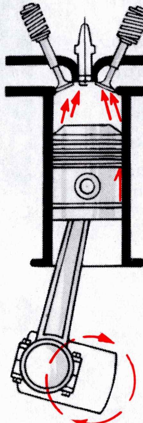
As the mixture burns it expands very rapidly, and with terrific power forces the piston down again. This third stroke of the piston is called the *power stroke.* As both valves remain closed, the rapid expansion of the gases forces the piston down, this being the only part of the assembly which can move. The power is thus transmitted to the connecting rod which turns the engine crankshaft . . . and so on, through the gear box and rear axle to the back wheels. This is the only stroke in all four-strokes which actually produces power.

When the piston nears the bottom of the cylinder the exhaust valve begins to open, and as the piston moves up on the fourth stroke of the cycle it pushes the burnt gases out past the open exhaust valve and through the exhaust pipe to the atmosphere.

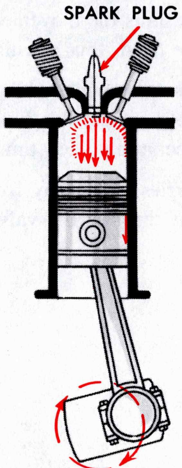
This stroke completes the cycle of operations of a four-stroke engine, the next stroke, a down stroke, being the inlet stroke of the succeeding cycle.



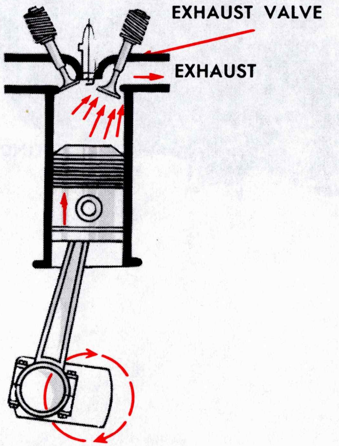
INLET STROKE



COMPRESSION STROKE



POWER STROKE



EXHAUST STROKE

Five main systems

The fundamental principles upon which the car engine operates have now been described, but there are more units to be described before the assembly is complete.

First, the fuel system. It consists of a fuel pump, which pumps the petrol from the main tank to the engine. From the fuel pump the petrol passes into a carburettor, in which it is mixed with air and atomised before it is drawn into the cylinders.

The charge enters the cylinders through the intake manifold, a pipe-like arrangement bolted to the sides of the cylinders. The burnt gases leave through another pipe called the exhaust manifold.

Secondly, the ignition system. It consists of a battery, ignition coil, distributor, and spark plugs. The ignition coil provides the high voltage necessary to ignite the fuel-air mixture at the spark plugs. The distributor distributes the electricity to the spark plugs in the correct order and at the right time.

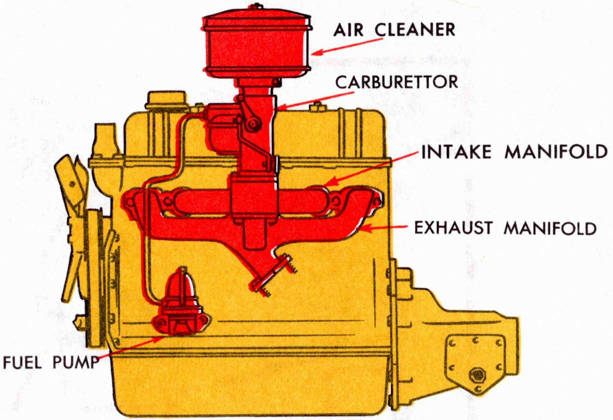
Thirdly, the electrical system. This consists of an electrical generator, which provides the electrical power for the ignition system, and also for such items as lights, horn and windscreen wipers, once the engine has started. A starter motor is also provided which, when supplied with electricity from the battery, will turn the engine in order to start it.

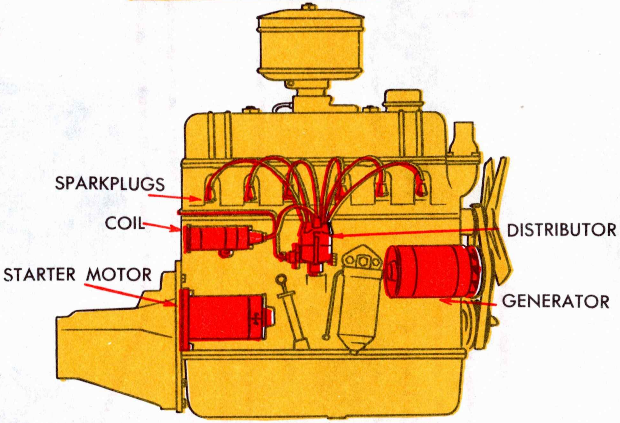
The cooling system is the fourth system. A water pump driven by a belt from the engine crankshaft circulates water from the engine to the radiator where it is cooled and returns the water to the engine. A fan is also provided to assist the flow of cooling air through the radiator.

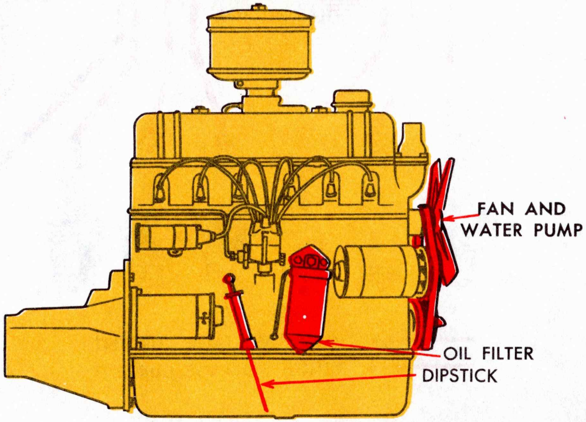
The cooling fan is driven directly from the crankshaft by a belt.

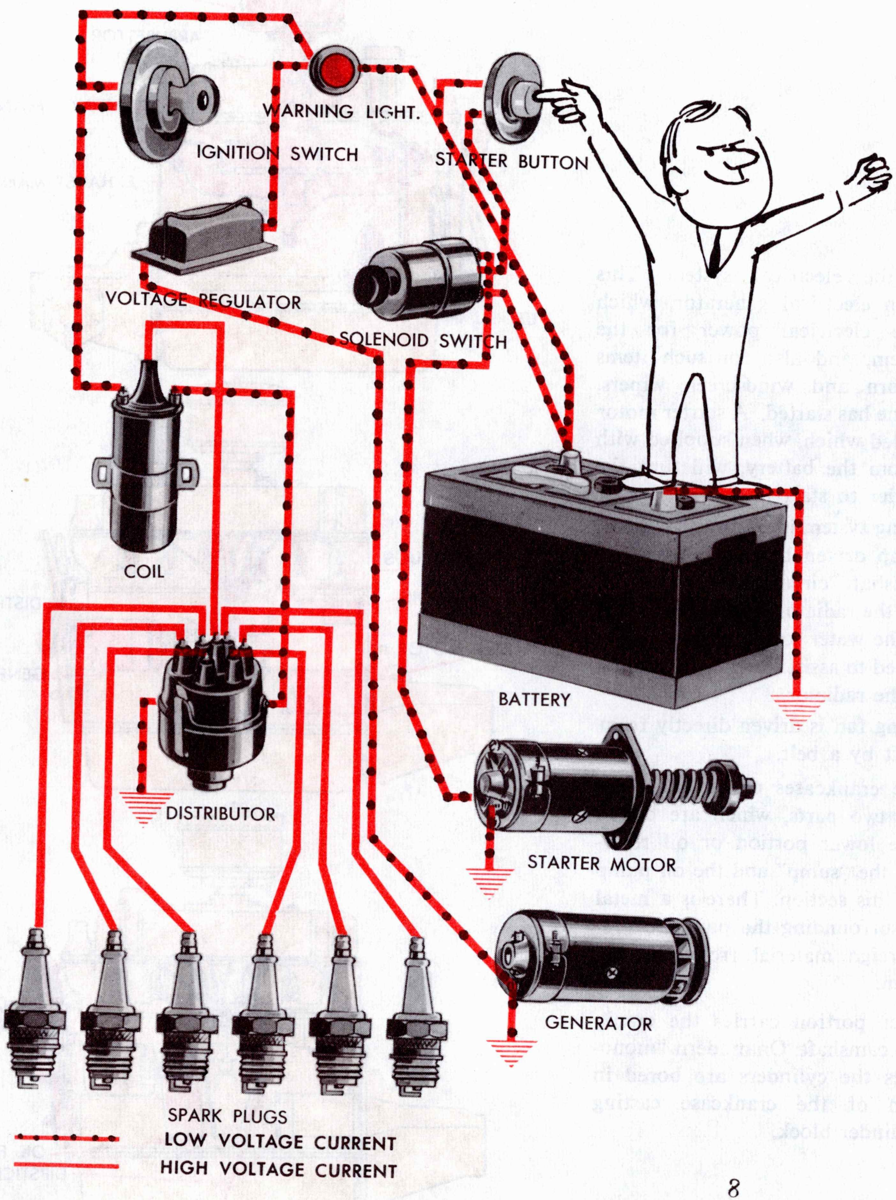
Fifth, the crankcases of most engines are made in two parts, which are bolted together. The lower portion or oil reservoir is called the "sump" and the oil pump is located in this section. There is a metal wire screen surrounding the pump to prevent any foreign material from entering the oil system.

The upper portion carries the crankshaft and the camshaft. On modern "monobloc" engines the cylinders are bored in an extension of the crankcase casting called the cylinder block.








WARNING LIGHT.
IGNITION SWITCH
STARTER BUTTON
VOLTAGE REGULATOR
SOLENOID SWITCH
COIL
BATTERY
DISTRIBUTOR
STARTER MOTOR
GENERATOR
SPARK PLUGS
LOW VOLTAGE CURRENT
HIGH VOLTAGE CURRENT

When you press the starter

The starter button is merely a switch. When you press it, you complete an electrical circuit.

When the switch is closed, electricity is drawn from the storage battery and it flows through heavy wires into the starter motor. As the starter motor turns, a little pinion slides on its shaft, and its teeth mesh with the gear teeth on the flywheel.

The starter motor thus causes the flywheel to revolve, and when your engine starts, the pinion is disengaged from the flywheel. The generator, driven by the engine, "generates" electricity for re-charging the battery.

Electricity flows from the generator through the ammeter into the battery, a wire taking current to the ignition switch. You can tell if the generator is working by looking at the ammeter or warning light.

From the ignition switch electricity flows into the coil, where it is transformed from low into high voltage current, providing a "fat" spark at the sparking plug. As this high voltage current leaves the coil, it flows to the distributor, where it is "distributed" to the spark plugs in the proper firing order and at the correct time.

The distributor and the spark

The distributor has a moulded bakelite cap, in which the spark plug leads connect to the brass pick-up terminals.

Remove the cap and rotor, and you will see the upper end of a steel spindle. This is the end of the distributor shaft, revolved by gears from the camshaft.

Integral with the shaft is the contact breaker cam, and it has as many sides as your engine has cylinders.

The contact breaker arm is hinged at one end, thus allowing it to swing. In the centre of the arm is a fibre block, held against the breaker cam by a spring. Attached to the free end of the breaker arm is a platinum point. Opposite is another point on a fixed arm.

When the breaker cam revolves, the free end of the breaker arm swings back and forth, as the fibre follows the bumps on the breaker cam. It's like holding a stick against the spokes of a revolving wheel.

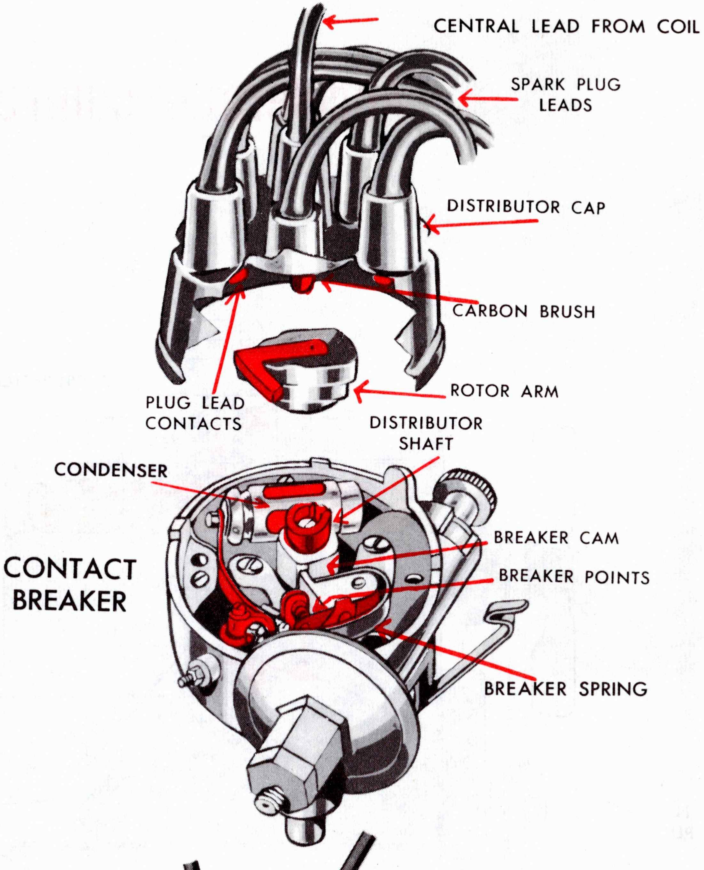
The breaker points come together, then break, as the arm swings. To allow the clearance between the points to be varied, the fixed arm is adjustable. However, it is a wise plan to let the dealer from whom you purchased your car or your Mobil dealer make all ignition adjustments.

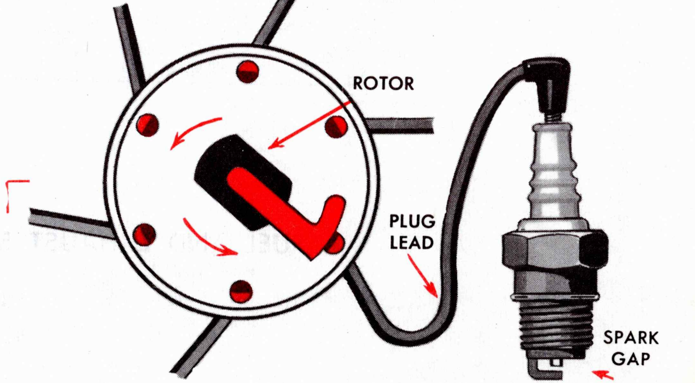
The purpose of the contact breaker is to interrupt the flow of current from the battery to the coil. The opening and closing of the contact breaker points make it possible for the high voltage to be built up in the coil at the right time to produce a spark at the plug.

A condenser is connected to the contact breaker points. Its purpose is to prevent an electric spark occurring as the points open as this would cause them to burn away.

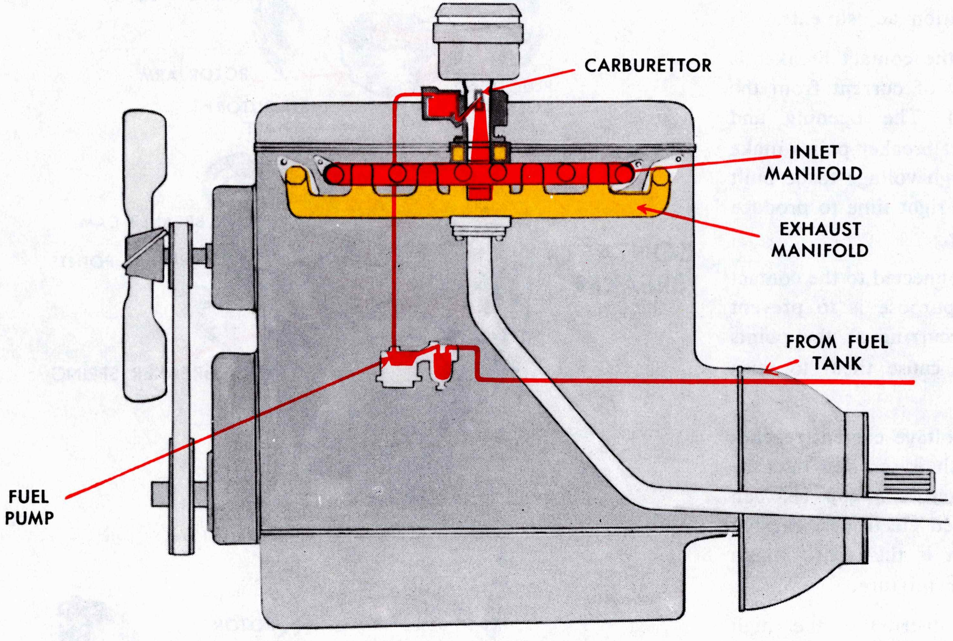
When the high voltage current reaches the spark plug, which is screwed into the cylinder, it jumps across a gap between two metal rods, called electrodes, causing a spark to occur. It is this spark which ignites the petrol/air mixture.

The distributor distributes the high voltage current to the spark plugs in the proper sequence required by the engine. Your rotor does this by making electrical contact with the studs embedded in the distributor cap to which the spark plug leads are attached.





Accelerator controls the power



FUEL AND EXHAUST SYSTEM

When the starter motor turns the crankshaft the pistons move up and down in the cylinders. In the process a charge of petrol and air is drawn into the cylinders and when this is ignited by the spark plug, the engine starts.

The idea is to get the fuel to the cylinders in the most suitable form for combustion, that is, with the proper proportions of petrol and air. This is the way it is done.

We have seen that the pistons cause a vacuum which draws petrol and air from the carburettor, through the inlet manifold into the cylinders.

The carburettor is a device which mixes petrol and air in the proper proportions and at the same time atomises the petrol. The inlet manifold conveys the petrol-air mixture to the cylinders.

Frequently the fuel tank is lower than the carburettor. For this reason a fuel pump is used to pump the petrol from the main tank into the carburettor.

When you press the accelerator down, you open, through suitable linkage, a valve in the carburettor and permit a charge of petrol-air mixture to enter the cylinder — just like turning on a tap.

Naturally, the further you press the accelerator down, the more petrol-air mixture can enter the cylinders because the throttle valve of the carburettor is opened wider. The result is that the engine develops more power and turns more quickly.

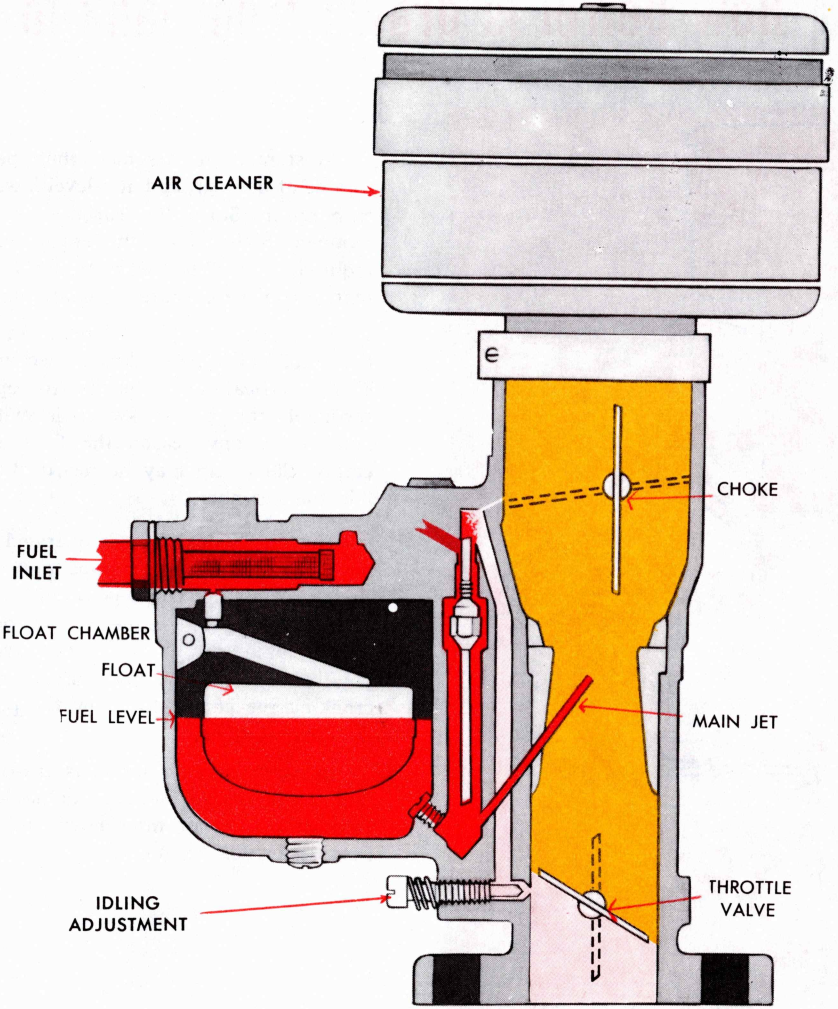
Remember that the more petrol-air mixture admitted into the cylinders, the greater the power and the greater the speed of the car. When you take your foot off the accelerator pedal the throttle valve of the carburettor closes and this naturally reduces the power and speed of the engine.

As a richer mixture is required for acceleration, the throttle valve of the carburettor operates an accelerating pump which injects petrol direct into the carburettor throat. It is because of this fact that the accelerator pedal should never be jiggled up and down; this will allow excess petrol to enter the cylinders and may cause the engine to stall.

The above remarks do not apply to the S.U. carburettor fitted to many U.K. cars. These carburettors do not have an accelerator pump but obtain a richer mixture by other means.

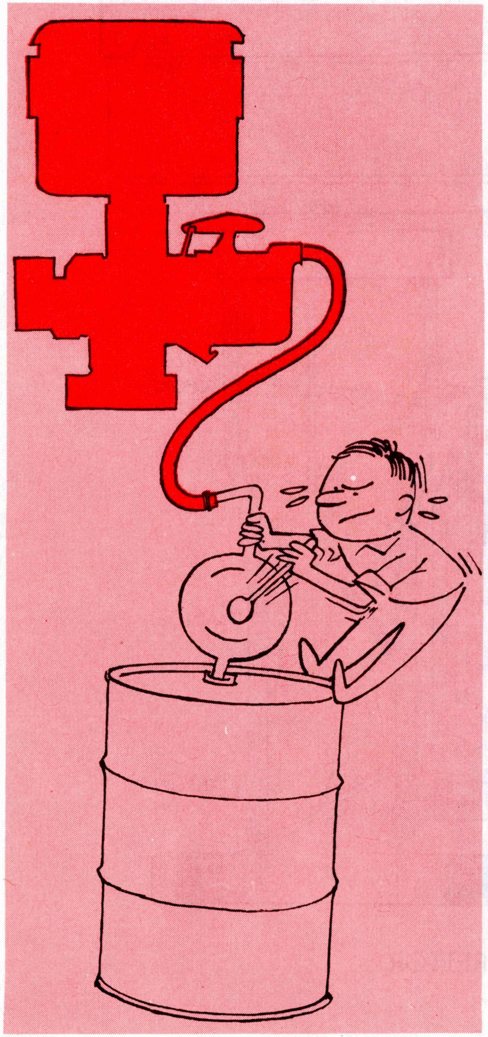
Approximately 34 cubic metres of air normally passes through the carburettor of an engine for each gallon of petrol burned. This air contains millions of particles of abrasive dust and other matter. Air cleaners are, therefore, used to remove this material, that would otherwise cause rapid engine wear and interfere with proper engine operation. Design of the air cleaner is usually such as to reduce also the noise resulting from the high-speed flow of air through the assembly.

There is often an air cleaner in the crankcase ventilation breather cap of the oil-fill pipe through which oil is placed in the engine crankcase. The purpose of this air cleaner is the same as that of the carburettor air cleaner—to remove abrasive dust particles from the air before it enters the engine. Air cleaners do their job efficiently, but they must be cleaned regularly if that efficiency is to be maintained without undue restriction of the air flow.



CARBURETTOR

How petrol is drawn from tank to carburettor



Most modern cars have their petrol tanks located at the rear, and at a level lower than the carburettor. Since the carburettor is usually mounted high up on the engine, a pump is required to "lift" the petrol from the tank at the rear, up to the carburettor float chamber.

There are two types of pump in use today: the electrical type and the mechanical type. The electrical type begins to operate immediately the ignition switch is switched on—and, if for any reason the float chamber is empty, the pump may be heard clicking as it fills the chamber.

The mechanical type is operated by a cam on the camshaft and pumps only when the engine is running. This type often has a priming lever to pump petrol to the carburettor manually during maintenance work, thus avoiding the physical effort or battery drain involved in cranking the engine to allow the pump to fill the float chamber.

In either case the petrol is drawn from the tank, by the pump, and is forced under pressure through a filter or filter bowl and on to the carburettor float chamber.

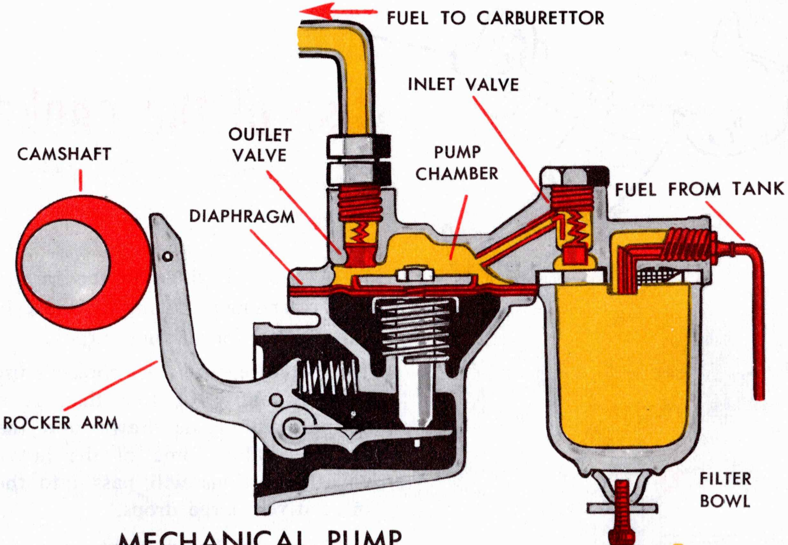
The quantity of fuel admitted to the float chamber is controlled by a float and valve arrangement not unlike that used in a water tank or cistern. This device ensures that the correct amount of fuel is present at all times to prevent fuel starvation or flooding.

Common carburettor troubles.

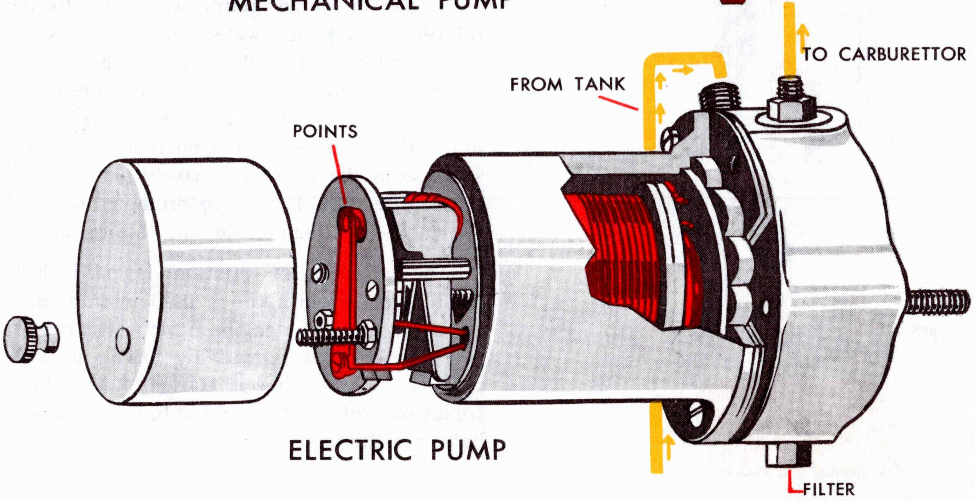
Water and foreign material such as road dirt and dust can soon block carburettor jets. It is for this reason that filters are fitted in the fuel system. Water may find its way into the fuel even if none is present when the petrol is bought. This is caused by the condensation of the moisture in the air which enters the tank as the petrol is being used. The tank is vented to the atmosphere to allow the air to enter, otherwise the petrol would not flow. The condensation occurs on the sides and top of the petrol tank as the outside temperature of the tank cools. It is because of this fact that the tank should always be kept full, particularly when a car is idle.

One of the most baffling causes of engine stoppage is petrol starvation due to "vapour lock". Petrol in the float chamber or in the fuel lines evaporates and does not arrive at the jet in the liquid form necessary for carburetion. This is brought about by high temperatures under the bonnet or a fuel line being too close to some hot component such as the exhaust manifold, or a combination of both. It will correct itself if the engine is allowed to cool, but a cure may often be effected by bending the petrol lines away from the engine. "Vapour lock" usually occurs when a car is stationary after a run in hot weather. The heat usually swept away from the engine is then radiated to the fuel system. Cooling the engine by parking so that a breeze will pass through the radiator, or in the shade, will often eliminate the trouble.

Another common trouble is when the pipe connecting the fuel tank to the fuel pump is leaking. Air enters the line and prevents petrol being pumped and the engine from starting.

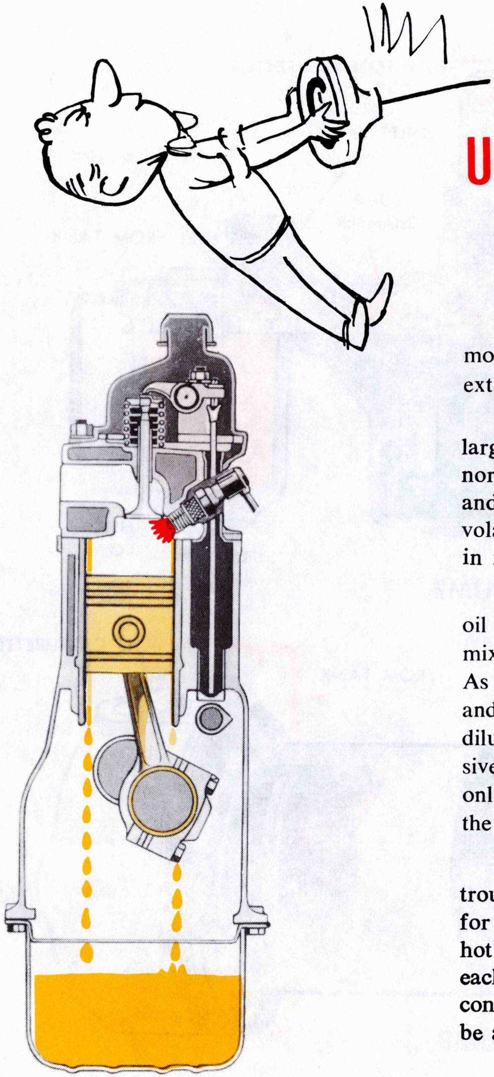

FUEL TO CARBURETTOR
INLET VALVE
OUTLET VALVE
PUMP CHAMBER
CAMSHAFT
FUEL FROM TANK
DIAPHRAGM
ROCKER ARM
FILTER BOWL

MECHANICAL PUMP


TO CARBURETTOR
FROM TANK
POINTS
FILTER

ELECTRIC PUMP

Use of the choke



A choke is fitted to the carburettor of a motor car engine to furnish the cylinders with extra petrol for starting purposes.

Therefore, when the choke is used, a much larger quantity of fuel than is needed for normal running is drawn into the cylinders and inevitably some of the heavier or less volatile portions will pass into the cylinders in relatively large drops.

Drops of liquid petrol will cling to the oil on the cylinder walls and ultimately be mixed with the oil by the action of the pistons. As shown in the illustration, the mixture of oil and petrol finally will reach the crankcase to dilute the crankcase oil. Consequently, excessive use of the choke is a costly habit. It not only wastes petrol but also promotes wear of the engine by thinning out the lubricating oil.

The problem of dilution is particularly troublesome when a car is used intermittently for short runs. The engine never gets properly hot and the choke invariably has to be used each time the engine is started. Under these conditions oil dilution and cylinder wear will be at a maximum.

It is good for such an engine to be operated under full load occasionally. This will tend to reduce crankcase dilution as it will evaporate some of the petrol which has diluted the crankcase oil.

At the other extreme a vehicle which seldom gets cold, such as a car operating as a taxi, may be run for 16 or even 24 hours a day, and record a very much larger mileage with no appreciable wear, largely because the choke is seldom used and oil dilution is at a minimum. Also, since the oil is seldom cold, lubricating efficiency is at a maximum and the cold starting period, when wear is highest, is largely eliminated.

Automatic chokes.

The carburettors of some modern cars are fitted with automatic chokes so that the amount of fuel drawn into the cylinders during the starting period is regulated in accordance with engine temperature. In this way the amount of petrol used during the starting period is reduced to a minimum.

Petrol and economy

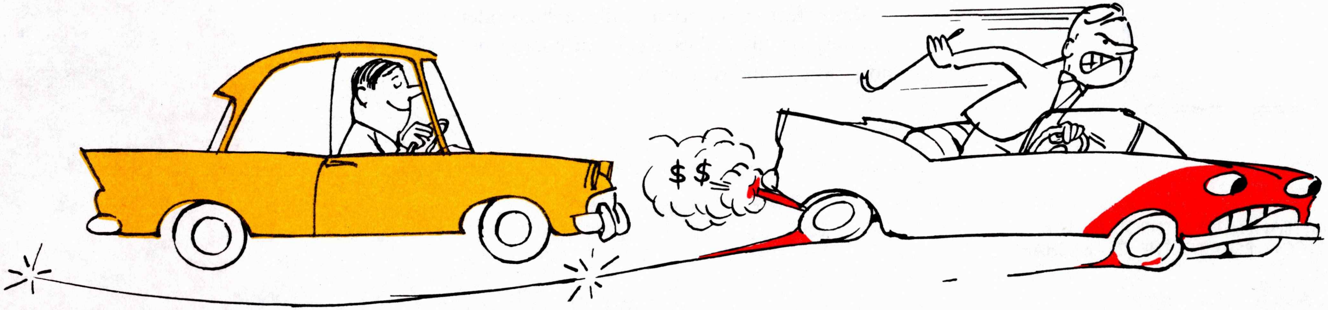
The Mobil Economy Run drivers have developed a driving technique that returns the greatest economy for all makes of motor cars. The basis of this technique is good anticipation or "look ahead driving."

Good anticipation means driving through and ahead of the car in front of you, watching for stop signals, cross traffic, pedestrians, etc. When you drive in this manner you have time to avoid sudden stops, or having to move quickly to keep out of trouble.

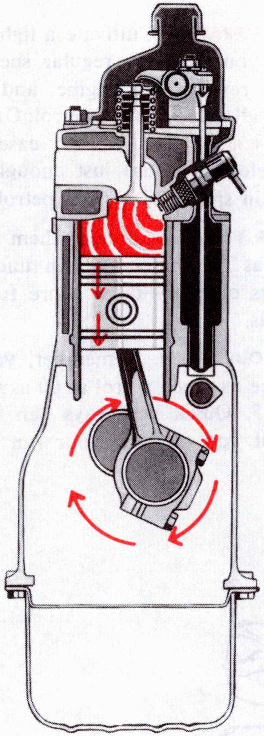
The Economy Run driver tries to make his car flow along the highway with the minimum of throttle movement. He considers the dunce of the highway to be the driver who speeds up one minute, slows down the next, jamming on his brakes or leaping ahead, all of which makes him a prime annoyance to other motorists and the greater user of petrol.

These points could help you drive with economy.

1. **YOUR SPARK TIMING.** An over-retarded spark robs you of power and mileage—causes engine to overheat.
2. **YOUR CARBURETTOR.** Adjust mixture and idling speed. An over-rich mixture and a fast idling engine waste petrol.
3. **WATCH YOUR PLUGS.** Faulty plugs, dirty plugs, old plugs all contribute towards petrol waste. Manufacturers recommend they be changed every 16,000 kilometres.
4. **THE CHOKE.** It's there to be used — not abused. Once you've started your engine, push it right in and you'll save petrol.
5. **YOUR ACCELERATOR.** Cultivate a light foot and maintain your car at a regular speed. Bursts of speed, revving the engine, and excessive speed are all consumers of petrol. Once you've attained your desired speed, ease up with your accelerator — use just enough pressure to maintain speed. This saves petrol.
6. **AND YOUR TYRES.** Maintain them at proper pressure as recommended. An under-inflated tyre wears quicker—takes more fuel to turn the wheels.
7. **WATCH YOUR SPEED.** Remember, you use almost twice as much petrol at 60 as you would use at 35. Quick get-aways can be fun at times, but you pay for your fun in wasted petrol.



Perfect combustion



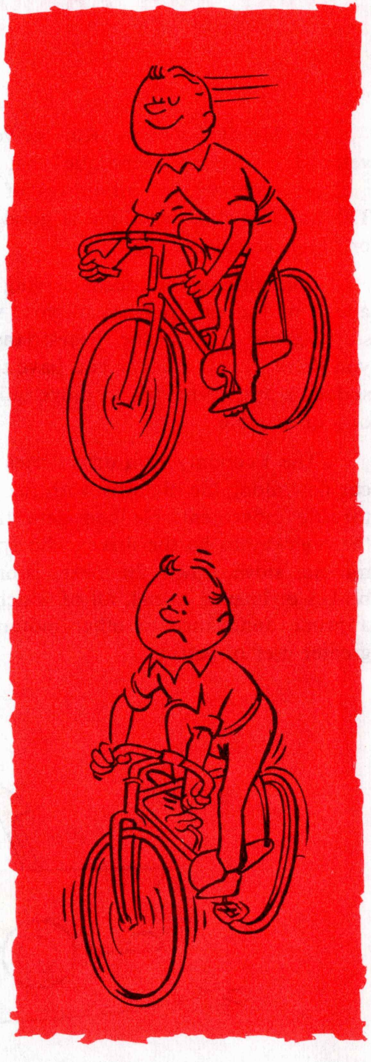
POWER IS TRANSMITTED THROUGH THE PISTON AND CON ROD TO THE CRANKSHAFT

Although the heat produced is great, petrol does not ignite all at once; that would be instantaneous combustion, which would simply jar the piston rather than push it down steadily and powerfully.

The burning process is only slightly slower but, as burning takes place, the gases expand and develop a tremendous pressure upon the piston, exerting a steady, powerful push. Naturally the piston moves down. The gases continue to exert pressure until the piston reaches the bottom, producing maximum power throughout the length of the stroke.

Perfect combustion is the same as the bike rider's smooth, powerful downward thrust, transmitting all energy and power to the rear wheel.

Imperfect combustion is like a bike rider jumping on his pedals. Lots of energy but no power at the rear wheel.



What is engine knock?

Many motorists have heard the metallic "ping ping" which occurs when a car is labouring up a hill or is called on for quick pick-up in traffic. Some call it "engine knock," others "detonation," but few know what it really is. However, all motorists know that "knocking" means lost power, harms the engine and lowers the possible mileage per gallon. All wish that it could be avoided.

The diagrams on the left illustrate perfect combustion. This requires a high anti-knock quality petrol which will stand up to the high temperatures and pressures encountered in modern engines. This petrol resists the disrupting influences of high compression and ensures even and steady combustion.

Power without knock.

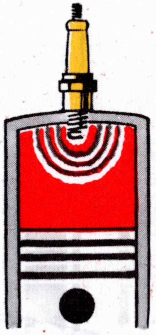
The expansion of the gases following the completion of this correctly timed combustion delivers the powerful thrusting push to the piston throughout the full length of the power stroke, mentioned in our last section.

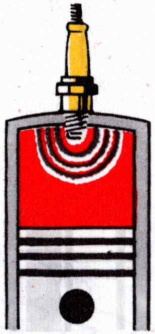
The diagrams on the right show how "knocking" occurs with petrols of low anti-knock quality.

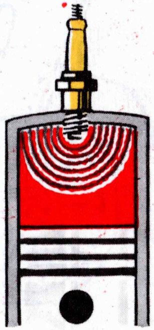
The spark ignites that portion of the charge which surrounds the spark plug and combustion begins to spread through the whole fuel charge. The rising temperature and pressure of the ignited portion raise the temperature and pressure in the unignited portion of the charge to its self-ignition point. This portion of the charge then burns very rapidly, causing high frequency pressure fluctuations that produce the sharp metallic noise called "knock." Retarding the spark timing will reduce the knock intensity but such action usually penalizes power output and fuel economy.

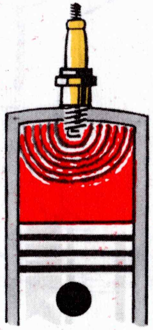
Mobil Super is the petrol designed to give knock-free performance. It satisfies the needs of all high compression engines, enabling them at all times to give the maximum output intended by the manufacturer.

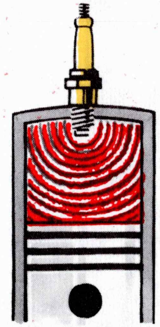
Mobil Regular is the petrol that meets the needs of the lower compression engines of older cars, trucks, and most farm tractors, and will provide full power at the greatest overall economy in these engines where "knocking" presents little or no problem.

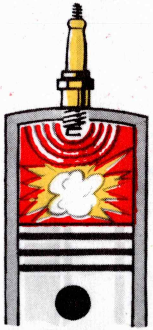

IGNITING THE CHARGE


IGNITING THE CHARGE

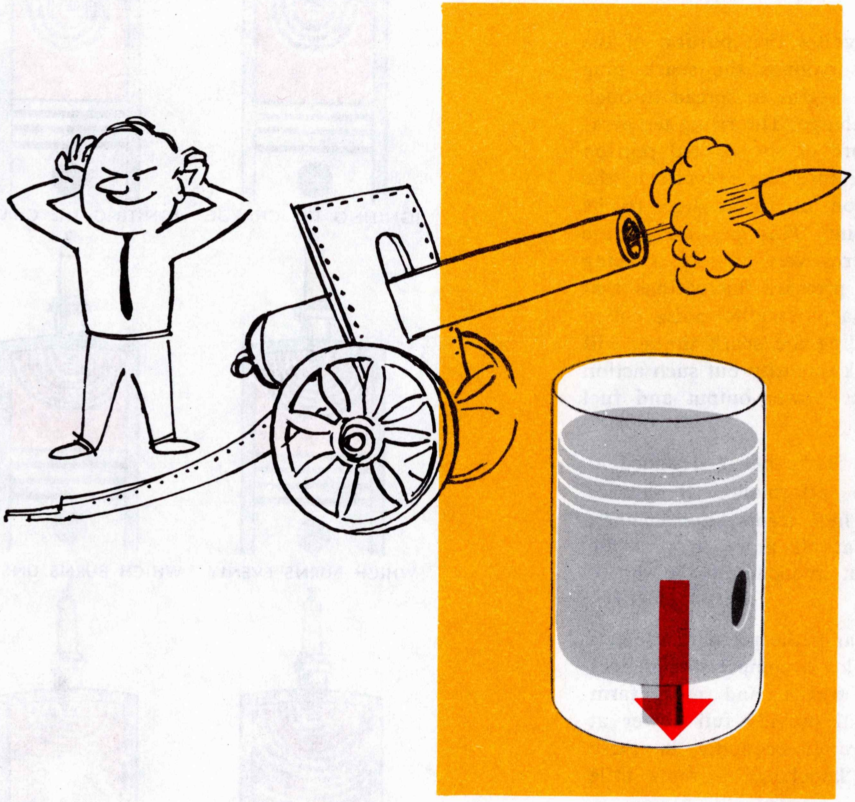

WHICH BURNS EVENLY


WHICH BURNS UNSTABLY


AND POWERFULLY


AND KNOCKS

Heat produces power.

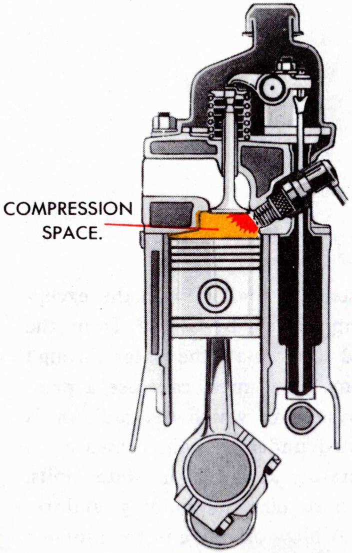


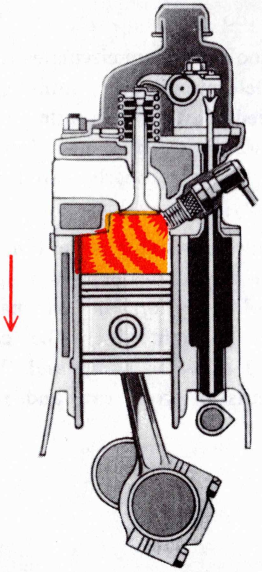
The normal car engine is called an internal combustion engine because the combustion of the petrol-air mixture takes place "inside" the cylinder. A steam engine is an "external" combustion engine because the fuel is burned in another chamber "outside" the engine cylinder.

After the petrol-air mixture is sucked into the cylinder the rising piston compresses it into a small space. This is called the compression space. The ratio that the total space in the cylinder, with the piston at the bottom of its stroke, bears to the compression space, is known as the compression ratio.

The power of the engine is largely dependent upon this ratio. And broadly speaking, the higher it is, the greater the power and efficiency of the engine. Acceleration and mileage are improved as the compression ratio is increased, but only to the limits of the octane rating of the fuel being used.

Compression ratios of modern cars vary from 7.5:1 to 9.5:1.





When the spark from the spark plug fires the mixture, it burns swiftly and with intense heat, developing very high pressures. Something must move and as the piston is the only movable thing in the cylinder it is forced downward at great speed, as a shell is fired from a cannon.

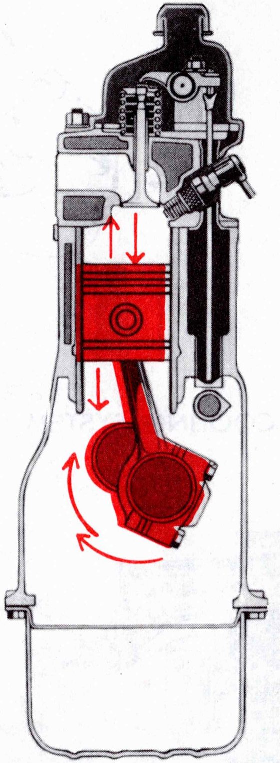
Thus power is transmitted from the piston, through the connecting rod to the crank arm. The crankshaft revolves, thereby transmitting the power to run the car.

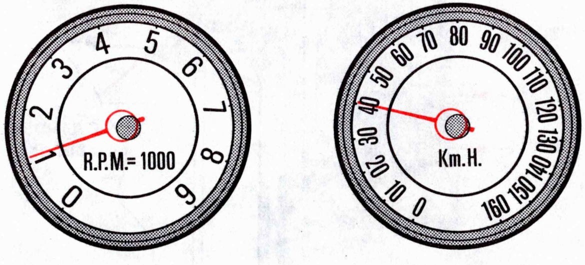
The pistons in a car engine move up and down within their respective cylinders at great speed. When an engine with a 114 millimetre piston stroke is running at 1200 revolutions per minute — a car speed of approximately 40 kilometres per hour in top gear — each of its pistons is travelling up and down within its respective cylinder at a rate of 2950 metres per minute.

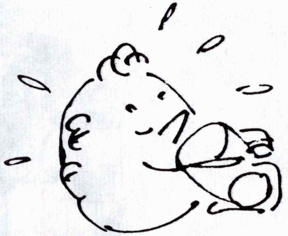
Up to 1980°C.

As the burning petrol-air mixture expands to produce power in the engine intense heat develops, resulting in a temperature up to 1980°C. Compare this with the temperature of boiling water — 100°C.

This temperature exceeds the melting point of iron, so the engine must be cooled to prevent it from melting. If it were not, its working parts would fuse together.







Cooling the engine

The quickest way to ruin a saucepan is to subject it to heat without putting any water in it. Without water to keep the temperature down, the metal will soon be destroyed. The same is true of your engine.

Most passenger car engines are water-cooled, which means that they rely upon cooling water to carry away the intense heat developed in the cylinder walls and head during combustion.

All water-cooling systems employ a radiator for cooling the water, which circulates through openings in the jackets surrounding the cylinders.

The water in the jackets absorbs the heat from the cylinders and carries it to the radiator, where it is cooled by flowing through tubes exposed to moving air.

Thermo-syphon and pump circulation.

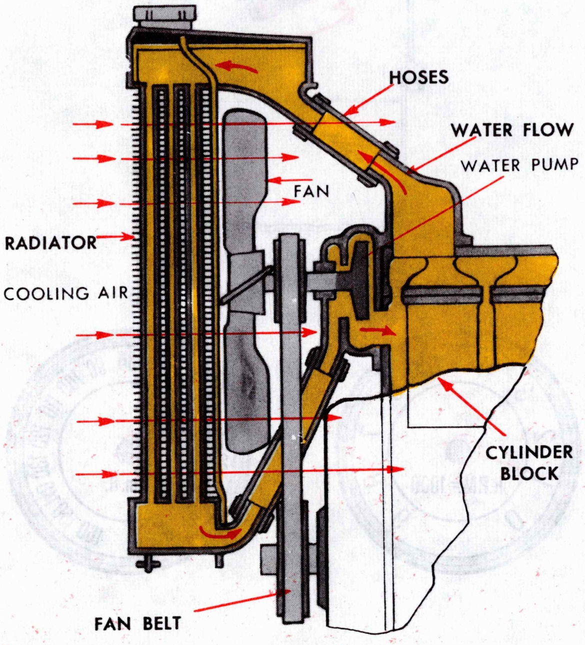
The thermo-syphon is the simpler system. It works on the principle that hot water rises, while cold water descends, thereby creating its own self-acting circulating system.

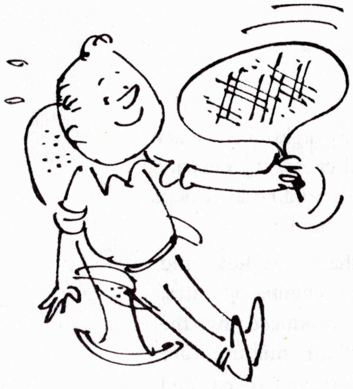
The other system is similar, with the exception that a pump driven by a belt from the crankshaft is used to circulate the water through the cooling system. Now, most cars use a pressurized cooling system in which the radiator is sealed and operated under a slight pressure, so raising the temperature at which the water boils. This results in more efficient running and reduced water loss. A blow-off valve in the radiator cap is included as a safety measure, should the pressure become too high.

Water in the cooling system circulates rapidly. It makes a complete circuit every minute, when you drive at a speed of twenty-five miles an hour. This makes the water pump a most important unit of the car. Unless properly cared for, it will not turn freely, or may leak.

Directly behind the radiator is the fan, which is often mounted on the water pump spindle. The fan aids cooling by drawing air past the radiator passages through which the cooling water circulates. The water pump and the fan are important units of your car, and require correct servicing.

COOLING SYSTEM



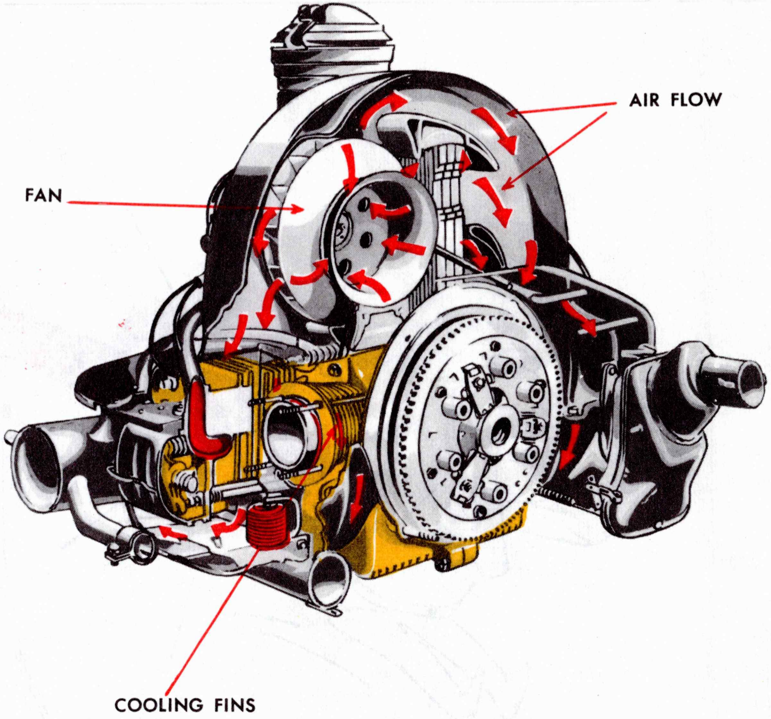


Air cooled engines

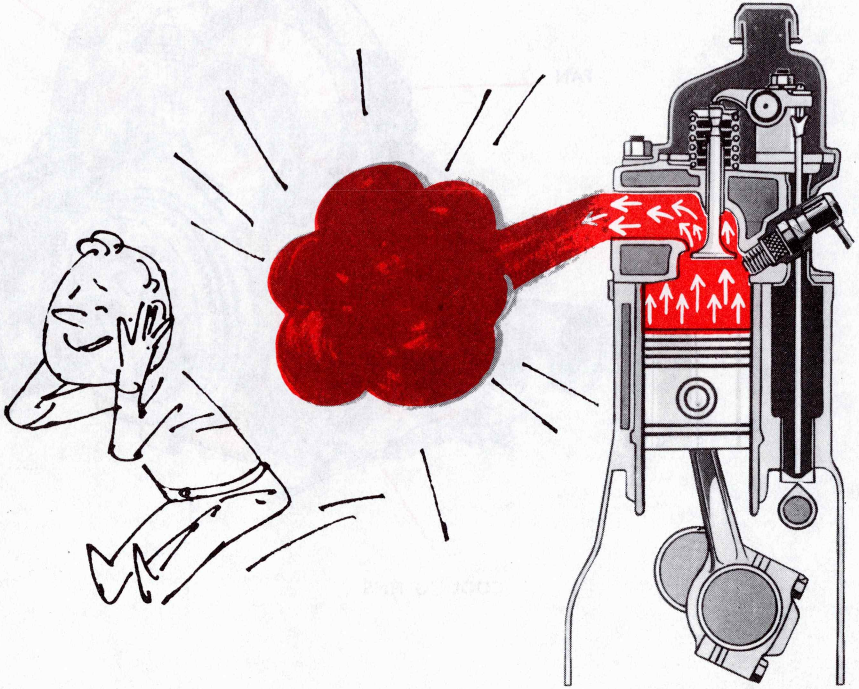
Some engines are cooled entirely by air. Air is directed to blow on and past the cylinders, which are fitted with fins, thus presenting a larger area of metal to the air, to get rid of as much heat as possible.

A large fan forces this cooling air through the airways around the engine. These airways perform a similar function to the water jackets of the water-cooled engine (as can be seen in the illustration). Both absorb heat and carry it away from the engine. A must for all owners of air-cooled engines is a spare fan belt, for without the fan this engine is the same as a water-cooled engine without water—it overheats and the parts fuse together.

Practically all motor cycle engines are air-cooled, as well as a large number of well-known aircraft engines and a few makes of cars.



Silencing exhaust noise



Thunder is produced by lightning, which heats the air around it, and causes it to expand with great rapidity. The expanding air causes the crash, which is called thunder.

We have described the great heat and pressure under which the engine operates. The hot exhaust gases, produced by the combustion of the petrol-air mixture, are expelled at high temperature and speed, and expand very rapidly.

When your car is travelling at 40 kilometres per hour, the exhaust gases are expelled from the engine at a pressure of approximately one hundred and seventy-two kilopascals — as great as the pressure in a tyre.

The hot expanding gases hit the outside air with a bang. You have heard the exhaust of an aeroplane engine. Your engine would sound much the same without some form of efficient silencer.

The secret of the quiet exhaust is to allow the gases to expand slowly and uniformly; this is what the silencer does for your car.

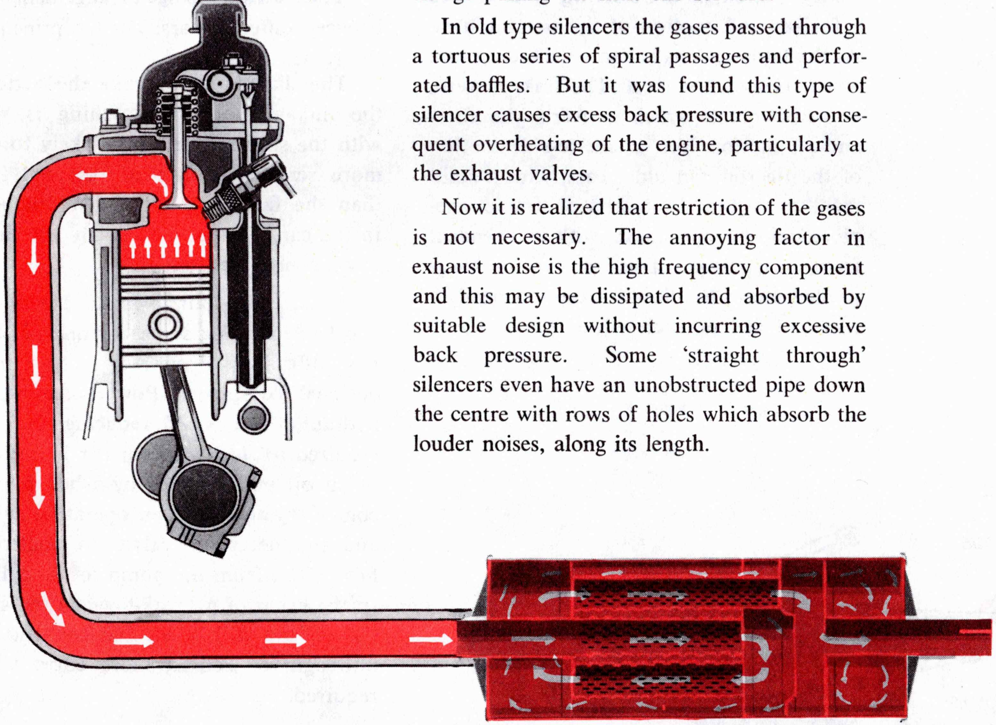
Instead of permitting the exhaust gases to come into immediate contact with the air, they are caught at the exhaust manifold and led through a long pipe to the silencer, which muffles the noise.

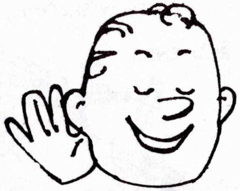
Silencers vary in design, but all work on the principle of allowing the gases to expand and cool before being released to the atmosphere.

A well designed silencer in good order acts as an ejector, the vacuum behind one outgoing charge pulling the next one forward.

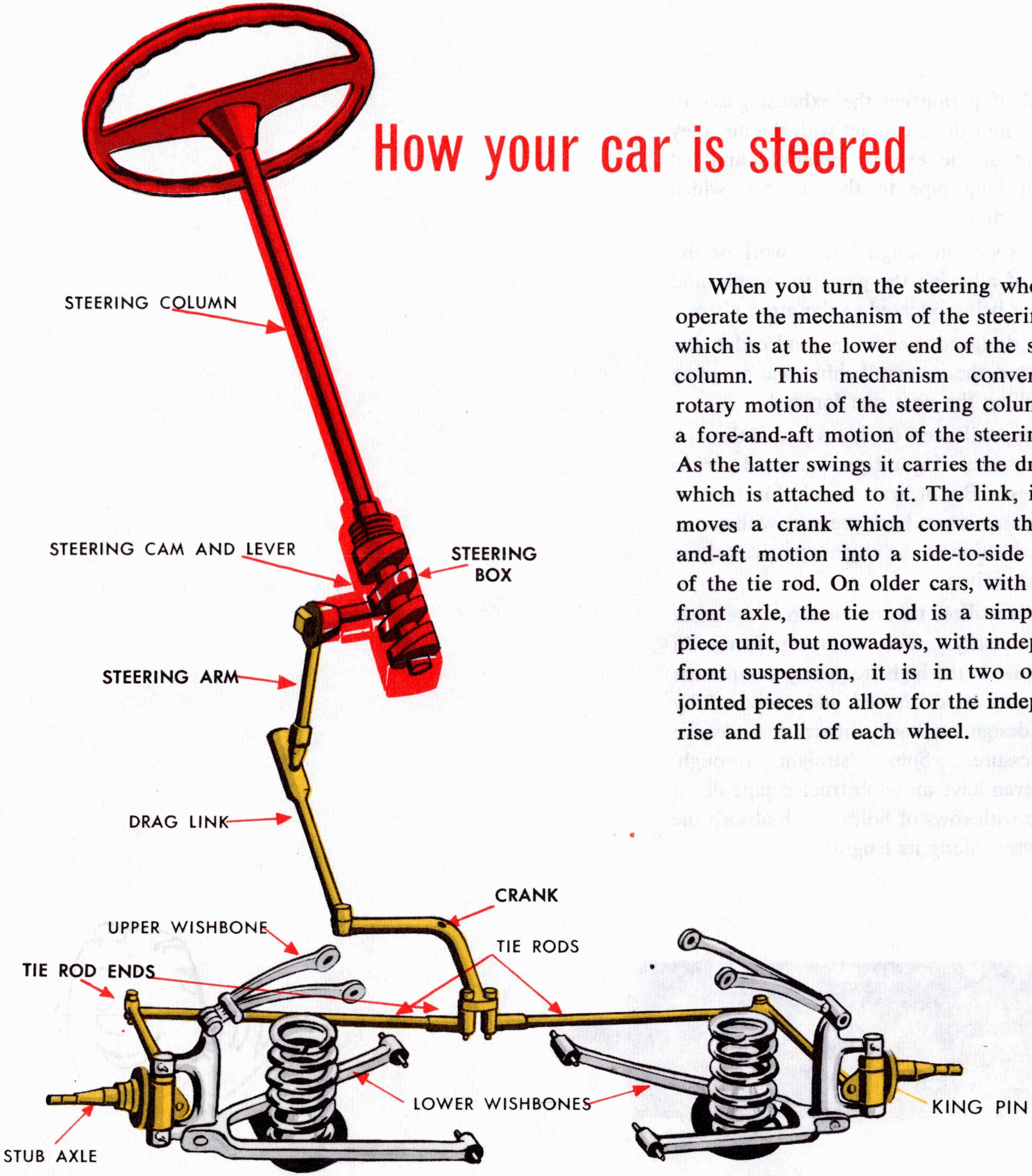
In old type silencers the gases passed through a tortuous series of spiral passages and perforated baffles. But it was found this type of silencer causes excess back pressure with consequent overheating of the engine, particularly at the exhaust valves.

Now it is realized that restriction of the gases is not necessary. The annoying factor in exhaust noise is the high frequency component and this may be dissipated and absorbed by suitable design without incurring excessive back pressure. Some 'straight through' silencers even have an unobstructed pipe down the centre with rows of holes which absorb the louder noises, along its length.





How your car is steered



When you turn the steering wheel you operate the mechanism of the steering box, which is at the lower end of the steering column. This mechanism converts the rotary motion of the steering column into a fore-and-aft motion of the steering arm. As the latter swings it carries the drag link which is attached to it. The link, in turn, moves a crank which converts the fore-and-aft motion into a side-to-side motion of the tie rod. On older cars, with a solid front axle, the tie rod is a simple one-piece unit, but nowadays, with independent front suspension, it is in two or three jointed pieces to allow for the independent rise and fall of each wheel.

The side-to-side motion of the tie rod steers the front wheels by causing the wheel stub-axles to pivot round the upright pivot pins, called "king-pins."

The steering linkage arrangement varies between different cars, but the principle is the same.

The diagram will make the action of the linkage clear. If anything is wrong with the steering gear, it is likely to cause more serious damage or personal injury than the failure of any other component in the car. This is particularly true in this day of high speeds.

In an endeavour to make driving safer and less fatiguing some car manufacturers now offer power steering as original or optional equipment. Power steering is a hydraulic means of reducing the effort required to steer a motor car and consists of an oil pump driven by a belt from the engine together with an operating cylinder and the necessary valves to control the flow of oil from the pump to the cylinder. In the event of a breakdown in the system the car can still be steered conventionally although, of course, more effort will be required.

The action of the clutch

If you hold three coins, two-two cent pieces separated by a ten cent piece, between your fingers, you will find it easy to rotate one coin without turning another.

Squeeze the coins together and it's difficult to revolve one, without turning all three, even though the pressure is not more than a few pounds.

Now picture these discs held together under a pressure of three hundred pounds, and you will agree that it would be extremely difficult to turn one without the others.

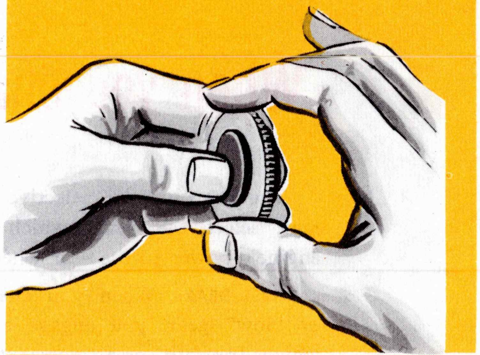
That's the principle of the clutch, the device which enables you to apply or release the power of the engine.

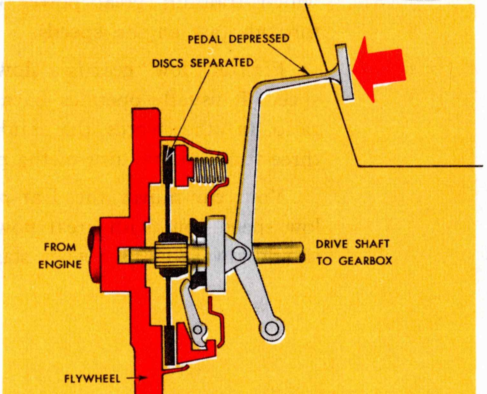
The clutch is composed of discs, two of which revolve with the engine, and another which turns with the gears.

When you press on the clutch pedal the discs become separated. In other words, they are "de-clutched." When you allow the pedal to return to its normal position the clutch plates are clamped together again by strong springs.

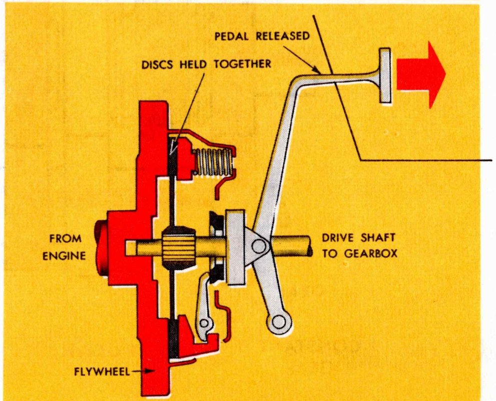
If you push the clutch pedal only part of the way towards the floor boards of the car, the various clutch discs run against each other. This is known as "slipping the clutch" and is very destructive to the surface of the discs. This is one reason why you should not rest your foot on the clutch pedal whilst driving.

Incidentally, it's dangerous to attempt gear changing without using the clutch. If you try it, you may tear the teeth from the gears. Pushing in the clutch pedal removes the load and allows them to mesh safely and quietly.





CLUTCH DISENGAGED



CLUTCH ENGAGED

When you change gears

The gear box is "selective" because you may select the gears which transmit the engine's power to the rear wheels.

FIRST GEAR: When you change into first or "low" gear, you engage a set of gears which transmit great power to the wheels through fast engine speeds.

First or "low" gear is a slow but powerful speed. It usually operates on about a 3 to 1 ratio. In other words, the crankshaft revolves three times to one turn of the propeller shaft.

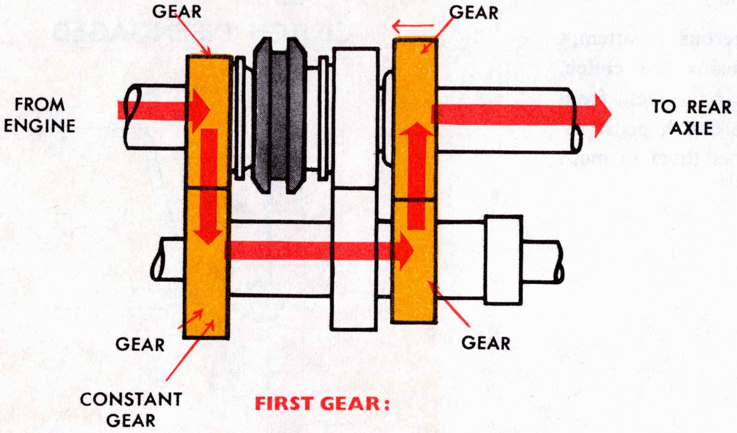
Your car moves ahead at proportionately low speed—but with great power. First gear should always be used when starting your car.

SECOND GEAR: When you change into second, you engage other gears which increase your car's forward speed, but decrease its pulling power.

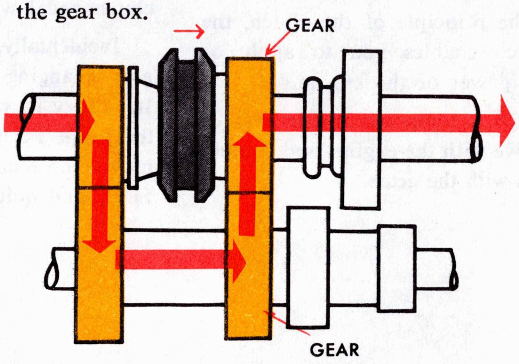
Second gear sacrifices power in favour of speed. It usually operates on an approximately 1¾ to 1 gear ratio.

THIRD GEAR: Perhaps you have wondered why third gear (in a three speed gear box) is not as noisy as the first or second gear. The reason is that in high gear you are not driving through a set of gears.

Third or top gear connects the crankshaft with the mainshaft in the gear box as though it were one shaft. As a result, one turn of the crankshaft equals one turn of the propeller shaft. It's a 1 to 1 ratio. Top gear is the fastest, but least powerful, of all the gears in the gear box.



FIRST GEAR:



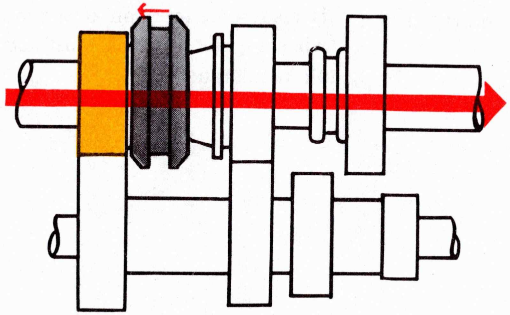
SECOND GEAR:

REVERSE GEAR: Reverse gear does not make the engine run backwards, as some people may believe it does.

If you watch two gears revolve against each other, you will see that they turn in opposite directions. You take advantage of this principle and put it to work when reversing your car.

Reverse gear is often the slowest, but most powerful, of all the gears in your transmission.

When four speeds are used there is a re-adjustment or balance of the intermediate gear ratios as top gear is a direct drive, on either a three or four speed gear box.



THIRD GEAR:

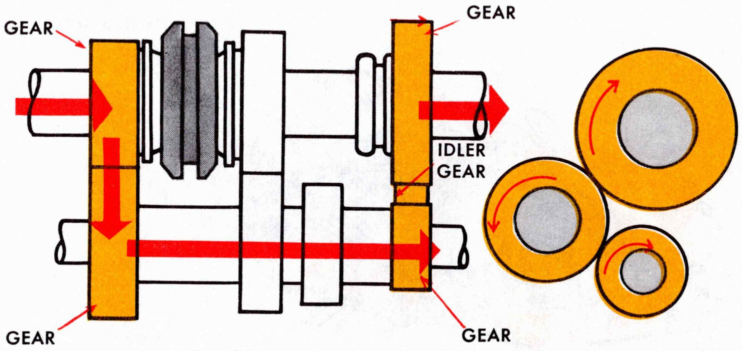
There are usually eight gear wheels in the gear box if it contains three forward speeds. These gears are made with a number of teeth on them like those on a watch wheel.

When meshed, the teeth of one gear engage the teeth of its mate, and exert thereon the necessary leverage to make the gear wheel revolve.

Transmission gears work together under tremendous pressure. At times they carry a load of more than two tonnes.

A meagre knowledge of mechanics will tell you that gears must not come together without a lubricant between them. If they do, they will wear quickly and become noisy.

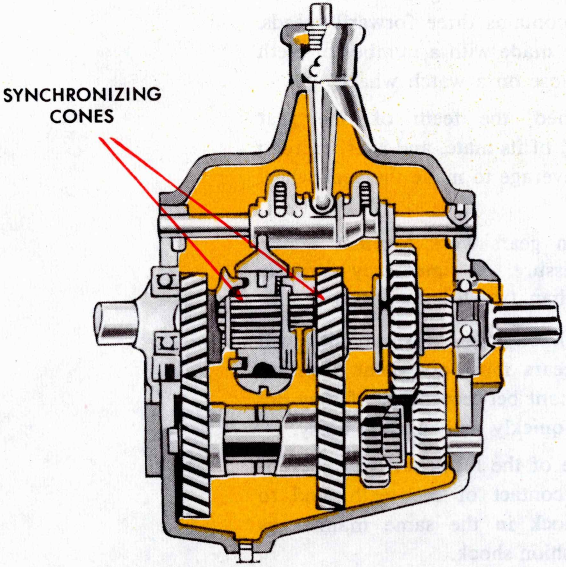
The purpose of the lubricant is to prevent metal-to-metal contact of the teeth, and to cushion the shock in the same manner as rubber tyres cushion shock.



REVERSE GEAR:

Synchro-mesh

SYNCHROMESH GEARBOX



Gear changing, which has been the bugbear of many motorists, becomes a simple operation when synchro-mesh transmission is in use. The gear box shown diagrammatically on the left has synchromesh on second and top gears.

The engagement of the drive in second and third gears is made by means of, first, a small metal cone clutch and then a "dog" engagement similar to the top gear engagement on the ordinary type of gear box.

The first portion of gear lever movement engages the small metal clutch thus making the "dog" and gear turn at the same speed.

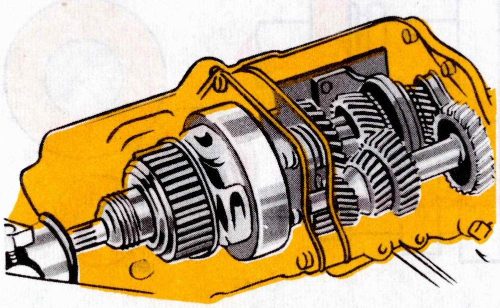
Continuing the gear lever movement to the full "in gear" position completes the "dog" engagement and the small metal clutch takes no portion of the driving load. Synchro-mesh gears ensure quiet gear changing.

Overdrive

Certain cars are fitted with what might be termed a two-speed auxiliary gear box at the rear of the main gear box, as shown bottom left. The purpose of this unit, which is known as the over-drive, is to give the effect of a still higher gear than the normal top gear.

Thus when cruising at high speed on level road, this over-drive, if brought into operation will lower the engine speed for a given car speed and for this reason it is usually claimed to show a reduction in fuel consumption.

Over-drive gear boxes are no more heavily loaded than ordinary gear boxes but they may have small passages and holes through which the lubricant must circulate to reach all the gears and bearings. There is also sometimes an over-running or free-wheeling clutch which must act freely under all temperatures.



OVERDRIVE GEARBOX

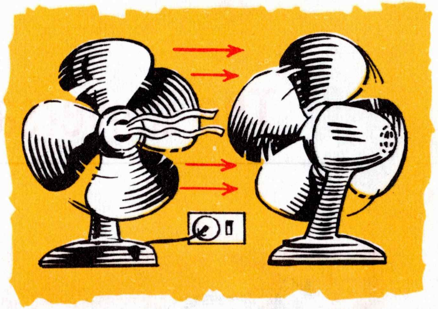
Automatic transmission.

An automatic transmission is, as the name implies, one in which the driver's gear shifting activities are reduced to the very minimum. The automatic transmission is so designed that the driver merely selects the general gear range—such as neutral, forward or reverse—and operates the accelerator and brake. The conventional clutch is omitted in transmissions of this type.

An automatic transmission comprises basically a two- or three-speed and reverse gear box linked to the engine by a hydraulic torque converter or fluid coupling, which takes the place of the conventional engine clutch.

The selection, timing and engagement of gears for the required speed ratio is accomplished automatically, through hydraulic operation, according to road speed and engine load, by a centrifugal governor and a system of valves. The selector lever operated by the driver actuates a manual control valve which selects neutral, reverse or the range of forward speed ratios desired. Usually, two forward positions are provided: one permitting all the forward gear ratios to be engaged automatically, and the other permitting the transmission to change only in the low gear ratios. The latter position is usually selected when the car is descending a steep grade or travelling through sand or mud.

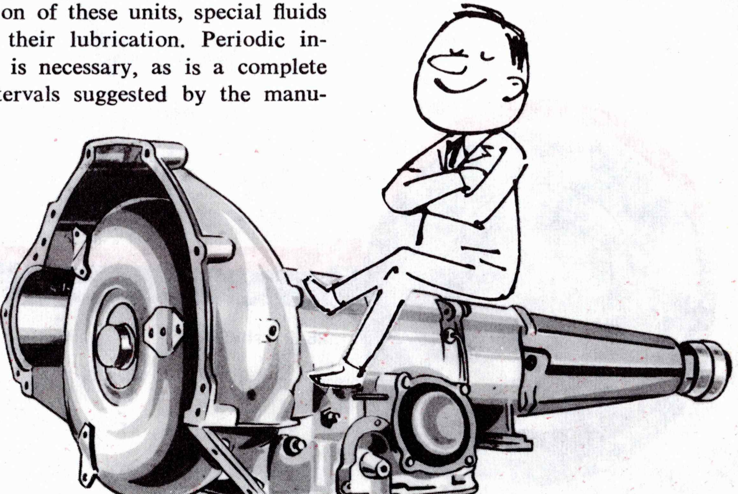
The action of the fluid coupling can be demonstrated by using two electric fans, placed facing each other at a short distance apart. If one fan is now switched on, the air flow directed from its blades will strike the blades of the stationary fan and cause them to revolve. The second fan's blades will gradually build up speed under the influence of this air flow until the two fans are revolving at approximately the same speed.



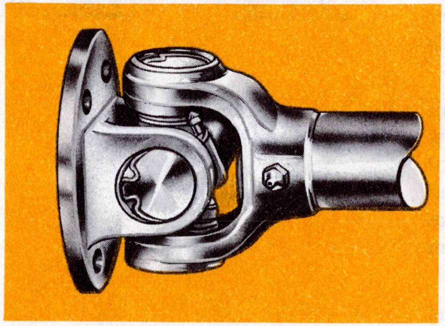
In the hydraulic coupling the case is similar except that instead of the fans, two bladed wheels are used which are sealed in a circular casing bolted to the engine flywheel and filled with oil which acts as the fluid medium instead of air. The first wheel, called the impeller, is driven from the engine and its blades direct the oil flow against the blades of the second wheel called the turbine, thus causing it to revolve. The turbine in turn drives the gears and the power is transmitted through the gear box to the rear wheels according to the speed range selected.

When the engine is idling, the turbine will not revolve as there is insufficient force from the oil flow to turn the blades. The car will remain stationary until the accelerator is pressed, causing the engine to speed up and the turbine and gears to turn. Thus, it is not necessary to disengage gear to prevent the car from moving away after bringing it to a standstill.

Because of the many functions which the oil must perform in the operation of these units, special fluids are recommended for their lubrication. Periodic inspection of fluid level is necessary, as is a complete change of fluid at intervals suggested by the manufacturer.



The universals



So far we have followed the transmission of the power of the engine through the clutch and into the gear box, where it may be changed to a more usable form as and when required.

The power now leaves the gear box, and is relayed to the rear end of the car through a universal joint and a propeller shaft.

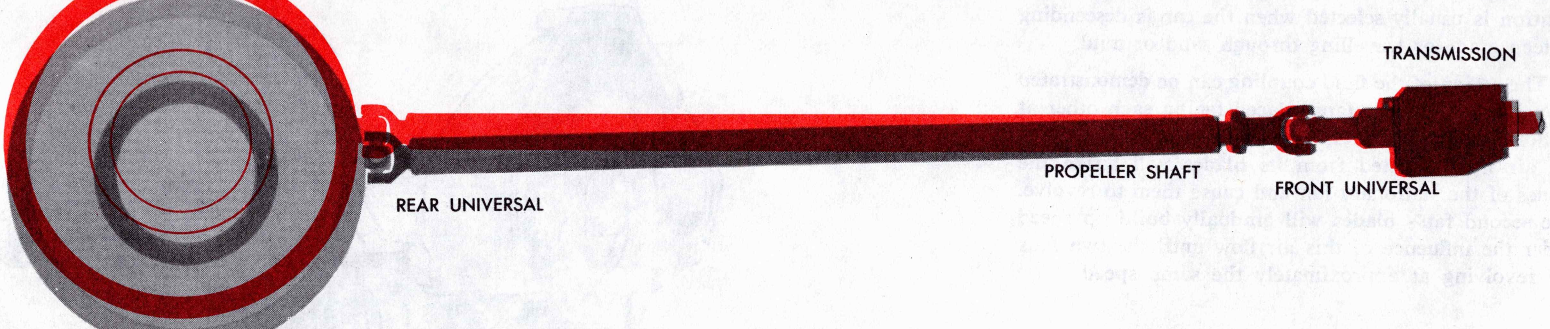
If you watch the rear wheels on the car ahead, you will notice that they bounce up and down according to the unevenness of the road.

To prevent damage to the driving units, every car has at least one universal joint (some cars have two) fastened at the front or both ends of the propeller shaft.

The universal joint is a flexible coupling which permits the propeller shaft to turn at an angle. It works like the links in a chain.

Lubricating Universals

Many universal joints are of the roller or needle bearing type which are packed with lubricant and require additional lubrication only when dismantled at lengthy periods. Your Mobil dealer knows the maker's recommendation as to the type of lubricant required. This depends upon the type of sealing arrangement incorporated in the joint.

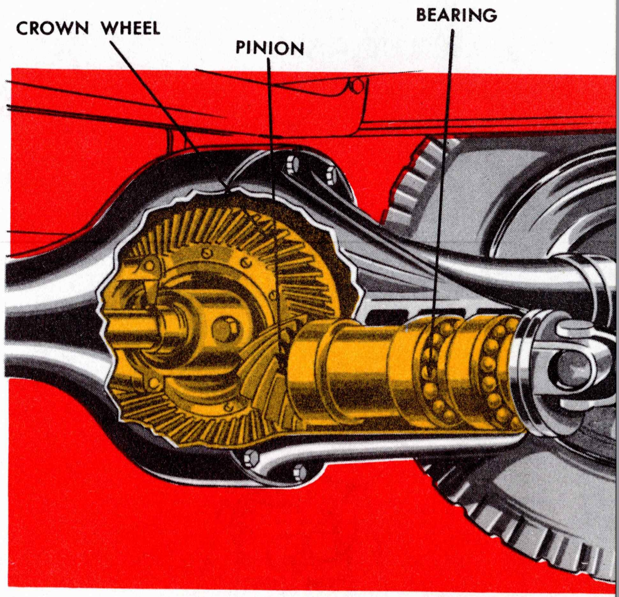


The rear axle

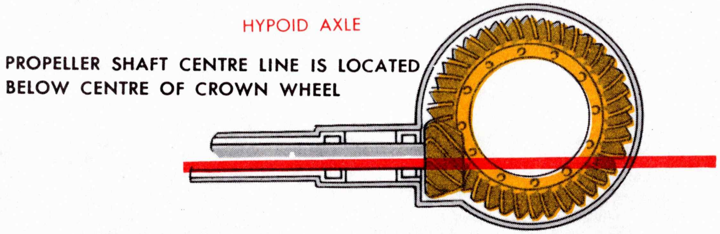
The rear axle contains the axle gears, the differential (see next page) and the axle shafts. The axle gears are called bevel gears since the gear teeth are cut on a cone or bevel. This is so that the drive from the propeller shaft is turned through a right-angle in order to turn the axle shafts, on which the bevel wheels are mounted, in the correct direction.

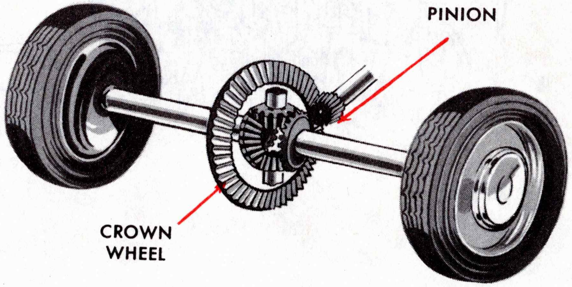
The rear axle gears consist of a small gear called the "pinion" and a large gear called the "crown wheel". The pinion is turned by the propeller shaft which meshes with the crown wheel and turns the axle shafts.

The word "hypoid" is frequently used in connection with these gears because in all modern cars the gears are of the "hypoid" bevel type. With this type of gear the centre line of the pinion is below the centre line of the crown wheel. If ordinary bevel gears were used, the two centre lines would intersect. Hypoid gears are much stronger and can carry greater loads than ordinary gears but require a special "extreme pressure" gear lubricant to effectively lubricate them.

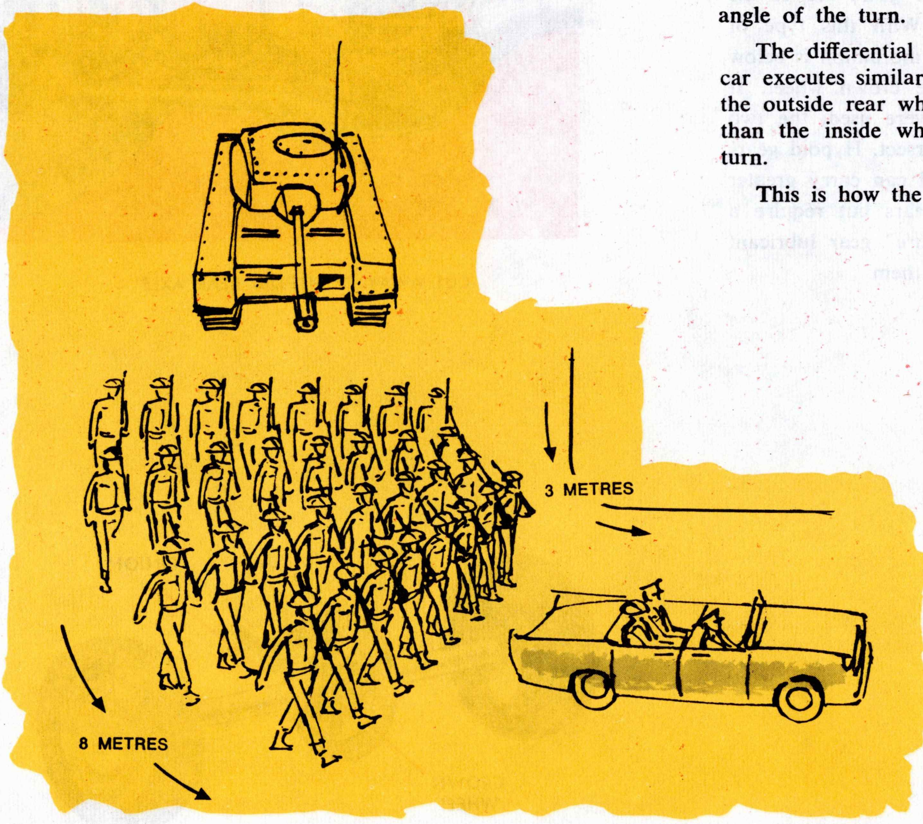

CROWN WHEEL
PINION
BEARING

CUT AWAY OF HYPOID REAR AXLE


HYPOID AXLE
PROPELLER SHAFT CENTRE LINE IS LOCATED BELOW CENTRE OF CROWN WHEEL


PINION
CROWN WHEEL

The differential helps you turn a corner



If you have watched a squad of soldiers make a turn, you have noticed that the pivot man marches but a short distance compared with the man on the outer end of the line. The pivot man takes short steps or marks time, depending on the angle of the turn.

The differential in the rear axle of a car executes similar movements. It drives the outside rear wheel faster and farther than the inside wheel when rounding a turn.

This is how the differential works.

In order that the outside rear wheel may cover a greater distance than the inside rear wheel it is essential that each wheel must have a separate axle. It is also essential that these two axles must be connected in such a way that they can rotate at different speeds when turning a corner. The diagram shows how this is done.

Let us break the axle into two "half-shafts" A and B, and fix a gear wheel C on to A, and a similar gear wheel D on to B.

Then, if we fit a floating gear wheel E which meshes with C and D, let us see what happens when we turn the road wheels.

How the differential works

If we hold the right hand wheel so that it cannot turn and then turn the left hand wheel, the gear C will turn. Since it is engaged with the gear wheel E, E must also turn. But the gear wheel D must remain stationary because we are holding the right hand wheel.

Summarizing, A must turn, therefore E must turn, while D remains stationary. The only way that this can happen is for the wheel E to revolve on its own axis and, at the same time, roll bodily round the periphery of the stationary gear wheel D, as shown by the arrows on the dotted track.

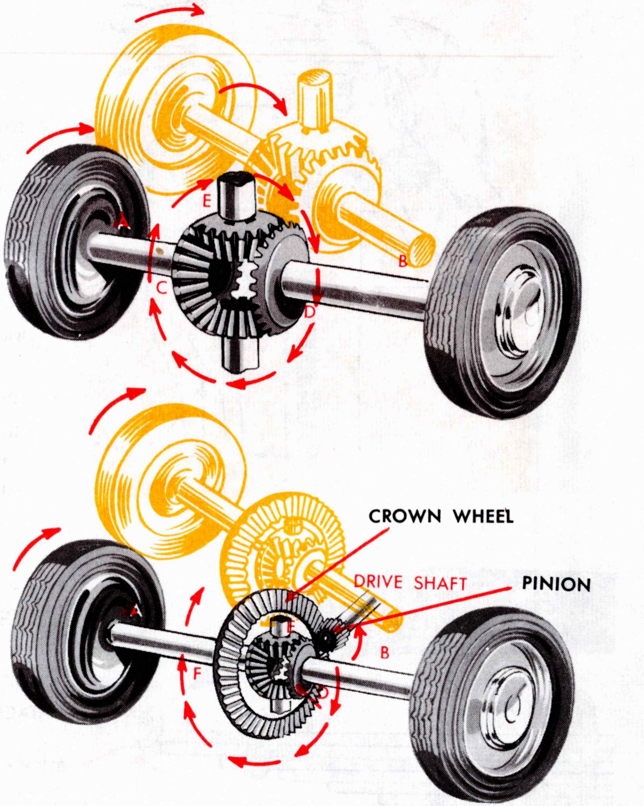
Thus, when one wheel has to turn faster than the other, the gear wheel E compensates for this by turning on its own axis and rolling round the periphery of the gear wheels C and D — this is the principle of the differential.

All that remains now is to connect up the propeller shaft of the car to this device.

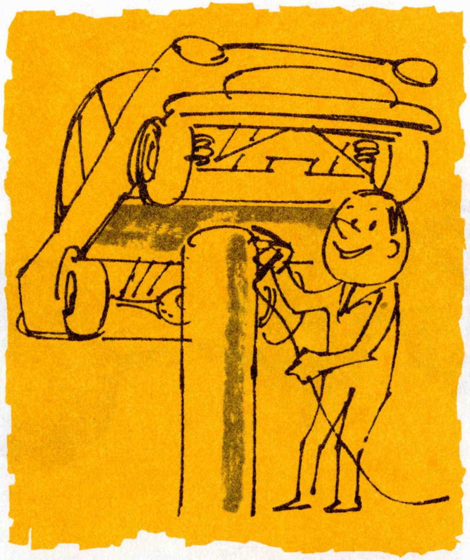
Obviously the propeller shaft must divide its attention equally between the shafts A and B. It cannot be fixedly attached to either.

Therefore, we must transmit the drive through the gear wheel E by turning it bodily round and round, and the crown wheel F does this job.

Look at the diagram.



The suspension system



Although present day design favours independent front suspension, most cars still use non-independent rear springing, with leaf springs which consist of leaves of spring steel held together by metal clips.

When you hit a bump, the springs straighten out and become "longer" Because of this they are attached to the frame with spring shackles. Shackles permit the springs to extend and shorten as conditions require — like a door hinge.

Springs are anchored in their shackles with shackle bolts, which pass through rubber bushes fitted in the spring ends. The rubber bushes ensure quietness of operation and do not require lubrication.

Some spring leaves should be lubricated to enable them to slide freely one over the other. Other springs are fitted with inserts between the leaves and do not require lubrication.

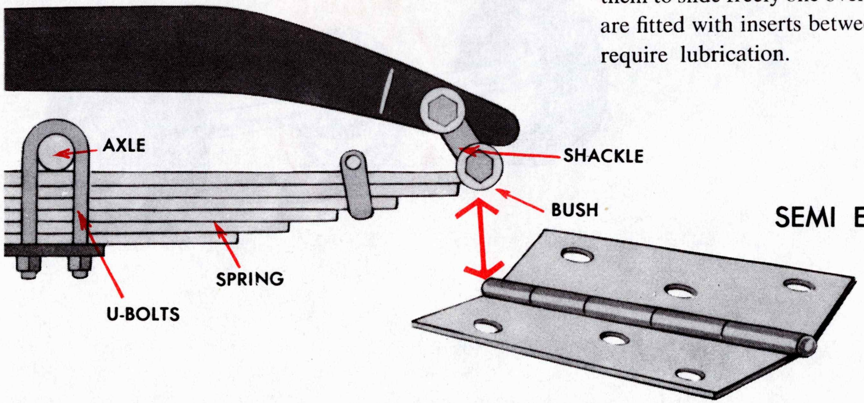
Independent systems

Independent suspensions usually consist of a coil spring and shock absorber mounted between two arms which are pivoted at the ends. These arms are often called the upper and lower "wishbones" as they resemble the wishbone of a chicken. Other types of independent suspension include torsion bars and swinging axle design.

The coil springs usually require no lubrication, although in some cases the spring is enclosed in a housing full of lubricating oil.

Special products are available for the lubrication of different types of springs.

Your local Mobil Service Station has special equipment for greasing your car. The dealer knows the lubrication requirements and locations of all the lubrication points. It is wise to let him do this work.



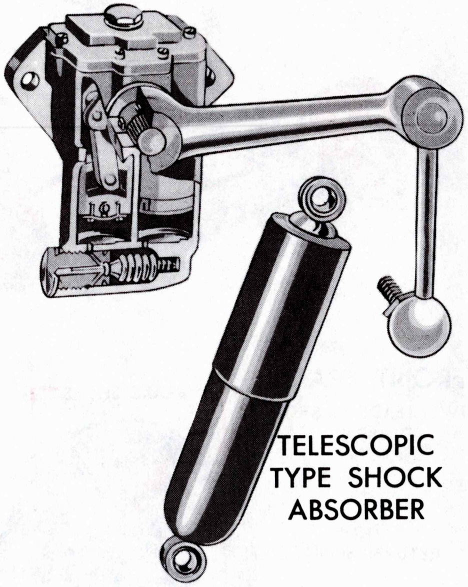
SEMI ELLIPTIC SPRING

Quite frequently, a stabilizer bar and connecting links are added in order to minimize body roll, or tipping. Usually the stabilizer bar passes through bearings on each side rail of the frame and is then attached by links to the lower arms of the wheel suspension system. When one spring is deflected by a sudden load, the stabilizer bar acts to transfer some of the load to the spring on the opposite side of the car, thus equalizing somewhat the load on both springs and preventing excessive body sway.

Shock absorbers are installed at each front and rear wheel to absorb sudden impact and prevent excessive spring rebound. Sometimes they are integral with independent wheel suspensions where this feature is employed. Shock absorbers are generally of the hydraulic type and are filled with oil which acts as the shock absorbing medium. They may be likened to small piston pumps, and operate very similarly to a hydraulic door check.

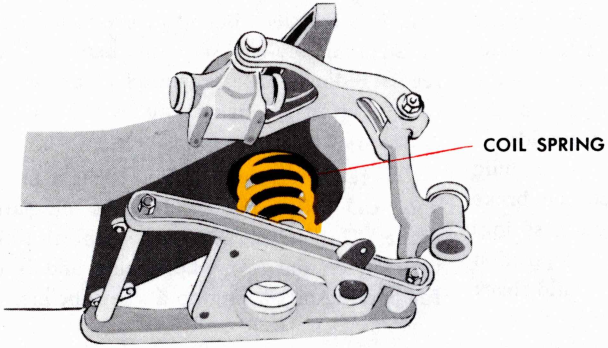
Some shock absorbers can be refilled with fluid, when leakage makes this necessary, without being removed from the car. Others must be removed and disassembled, while still other types require the installation of replacement units when servicing is performed. Shock absorbers are accurately constructed and contain fine clearances, so that great care must be taken to prevent the entrance of dirt or other foreign matter when servicing. To assure their proper operation, it is also important that only special shock absorber fluids be used for filling reservoirs.

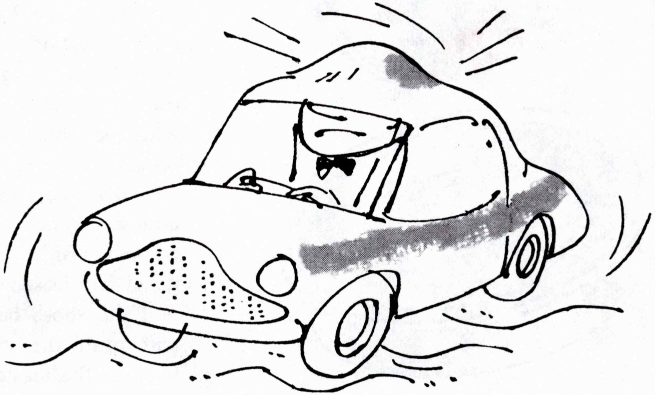
LEVER TYPE SHOCK ABSORBER

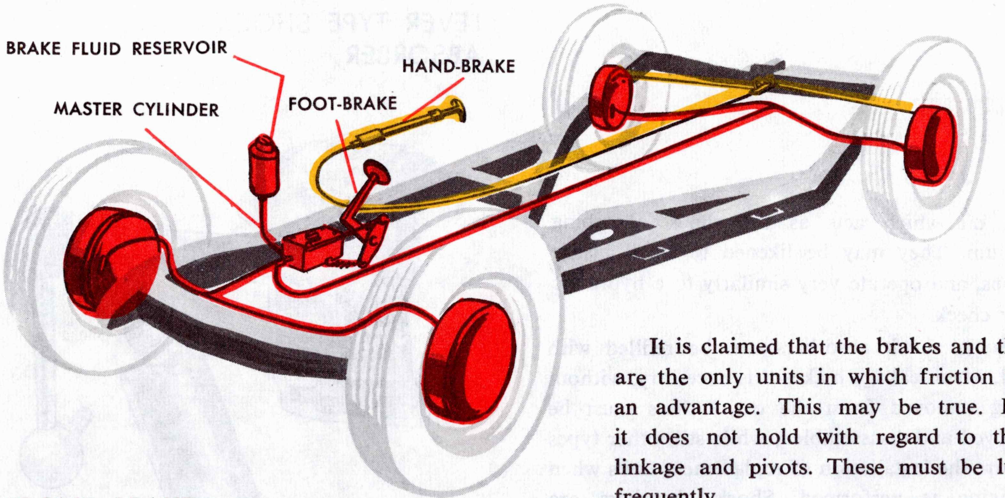


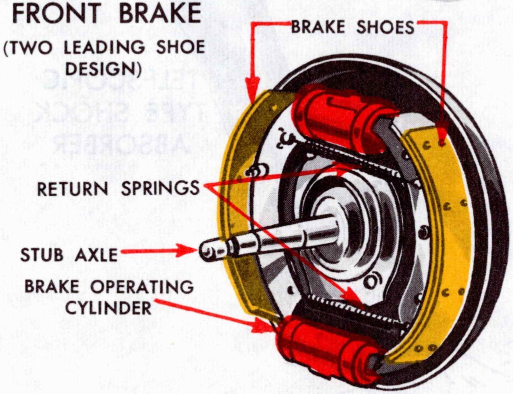
TELESCOPIC TYPE SHOCK ABSORBER

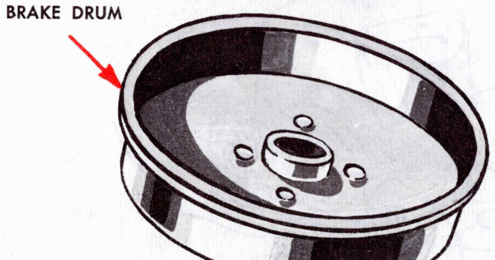
INDEPENDENT FRONT SUSPENSION











The braking system

It is claimed that the brakes and the clutch are the only units in which friction works to an advantage. This may be true. However, it does not hold with regard to the brake linkage and pivots. These must be lubricated frequently.

All modern footbrake systems are operated hydraulically. In other words, they rely on pressure other than direct mechanical linkage to press the brake shoes against their drums.

The principle of operation of hydraulic brake systems is that when the brake pedal is depressed it pushes a piston along a cylinder (called a master cylinder) filled with brake fluid. This cylinder feeds a pipeline to each wheel. At the brake end of each pipeline is another cylinder in which a piston is moved by the incoming fluid. This piston operates the brake shoes and brings them into contact with the brake drum. It will be seen that the operation of such a system depends on the fact that the brake fluid, like all liquids, is almost incompressible and acts as a fluid column inside the pipeline. When the brake pedal is released the brake shoe return springs pull the shoes back to their original position and push the column of brake fluid back towards the master cylinder.

A brake fluid reservoir is located on top of the brake master cylinder and it should always be kept full to prevent any air getting into the system. This would prevent the brakes from operating efficiently.

One of the jobs which may have to be done occasionally on hydraulic brake systems is called "bleeding". This entails removal of air bubbles which have found their way into the fluid. Bleeding involves the opening of a special bleeding valve at each wheel in turn and operating the brake pedal until the air bubbles are expelled from the system. The fluid thus lost must, of course, be made up in the master cylinder reservoir. This procedure will restore the firm action of the pedal.

The main advantage of a hydraulic braking system is that it is bound to exert equal effort at all four brakes. With mechanical brakes, regular adjustment is required to achieve this result, for as the name implies it is a mechanical system of rods and cables.

There is a second braking system fitted to your car called the hand brake or parking brake. This is usually a mechanical linkage working on the rear wheels only and is used for parking or starting up a steep incline.

For many years motor car brakes have been operated by forcing curved brake shoes into contact with the inside of a brake drum, as described earlier. A limitation of this system, particularly on fast and powerful cars, is the difficulty of getting rid of the heat which builds up in the brake drum as a result of repeated brake applications. The drum tends to be shrouded by the wheel and tyre and thus cool air is prevented from flowing over its surface.

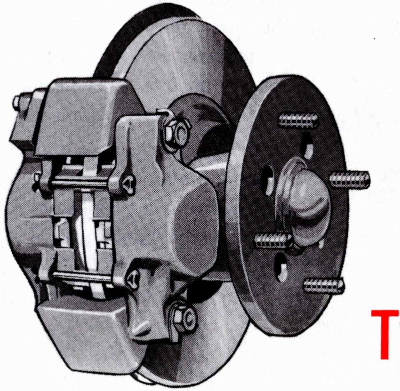
An excessively hot brake drum is a bad thing for a number of reasons, firstly the expansion can increase the gap between shoes and drum to the point where available brake shoe movement is only enough to contact the drum without actually pressing on to it. Secondly, the properties of the drum material are altered at high temperatures and cracking of the drum can occur. Lastly, the frictional properties of the brake shoe lining are reduced at high temperatures and the stopping power will be much less.

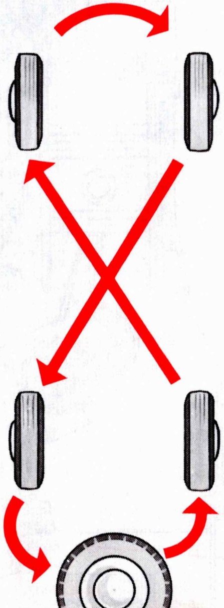
To help overcome disadvantages the disc brake was introduced consisting of a metal disc rotating with the wheel. The brake shoes are pads which, when the brake is applied, are pushed on to both sides of the disc, thus clamping the disc between them and slowing down or stopping the wheel.

The disc can be cooled much more effectively by the air flow and distortion is eliminated. One disadvantage of the disc brake is that there is no self servo or "wrapping" action as with a drum brake, consequently a heavier pressure is required at the pedal and power assistance is very desirable.

Power brakes have always been essential for heavy trucks and buses but recently they have made their appearance on a number of motor cars. This development is due to the ever increasing speeds and weights of modern cars, the accent on safety and ease of control and the advent of the disc brake.

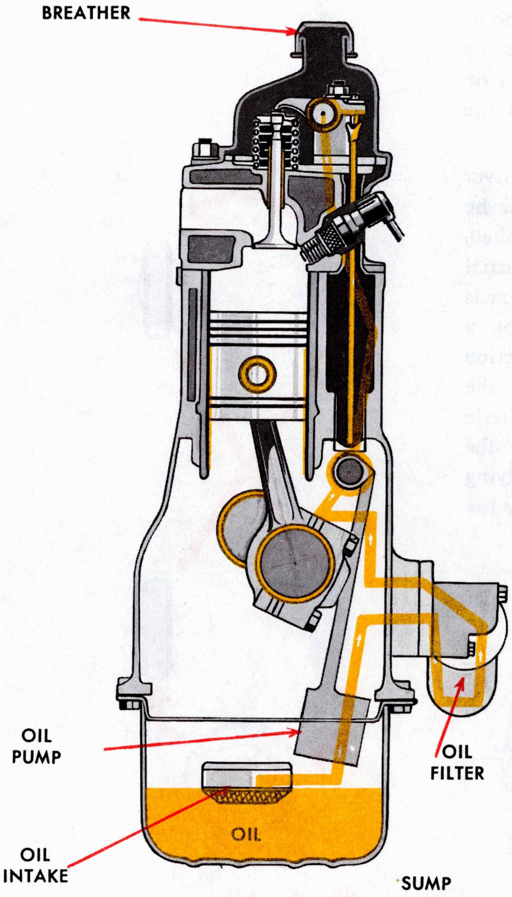
A power brake is a device to assist the driver in pushing down the brake pedal; the harder he pushes the pedal, the more assistance is supplied. Power assistance is derived from the partial vacuum that exists in the inlet manifold which is connected by pipe to a chamber containing a diaphragm. When a valve is opened by the action of the brake pedal, vacuum is admitted via the pipe to one side of this diaphragm; atmospheric pressure on the other side pushes against the diaphragm. This "push" then assists in applying the brake, thus reducing the effort required by the driver.





Tyre Rotation
Plan

How the engine is lubricated



FULL PRESSURE SYSTEM

There are many kinds of lubricating systems, but those most generally used may be summed up in three types or a combination of three.

The simplest — the splash system — splashes oil to the moving parts by the revolving crankshaft and the connecting rods.

The splash and pressure system, another type, splashes oil to some of the parts and pumps it under pressure to the more important moving parts.

In the third type, the full pressure system, all the moving parts are lubricated by oil, forced to them by the pressure of a gear-driven oil pump.

In these days of high compression engines, and higher engine speed, this system is used almost universally because of its positive action.

An oil pump consists of two gears encased in a close-fitting metal housing submerged in the lubricating oil at the lowest part of the engine crankcase. These gears mesh together, revolving in opposite directions. This draws the oil into the housing and forces it out under pressure to the parts which need lubrication.

Often an oil gauge is connected to the pump. It tells you nothing about the quality or quantity of your oil. It simply shows in pounds per square inch, the pressure exerted by the pump in forcing the oil through the engine. It tells you whether the oil is circulating, and also indicates the condition of the bearings; where the bearings are worn and slack, the resistance to the passage of the oil is not great and the pressure drops.

More commonly used is a warning light, which flashes on when the oil pressure is low.

An oil pump may be entirely submerged at all times in the oil in the engine sump or it may be located in an elevated position. In either case, the intake pipe of the pump is protected by a fine-mesh screen. Some intakes and screens are designed to float so that only relatively clean oil is drawn in by the pump. Others may be located that they are easily removed for cleaning when the crankcase is drained at the time of changing the oil.

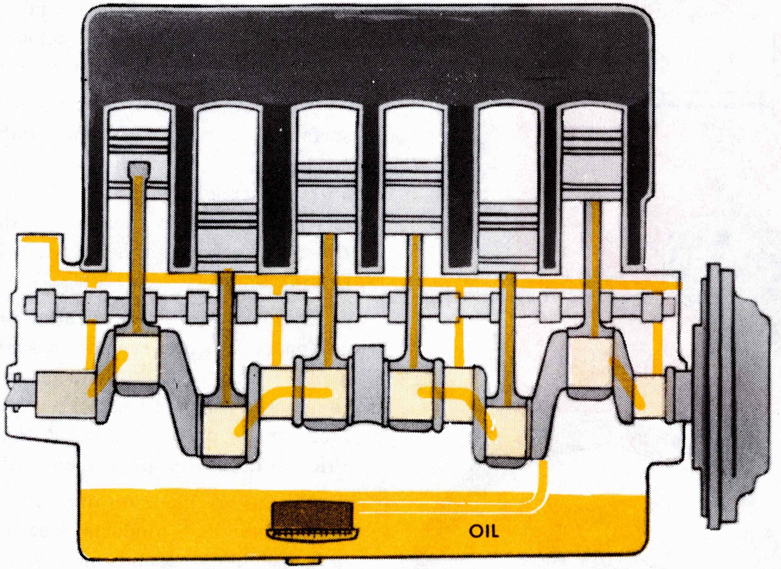
Baffles are installed in the crankcase to prevent oil in the sump from surging back and forth excessively due to car motion. This assures full pump capacity by confining an adequate quantity of oil around the pump intake.

Since the movement of the pistons continually varies the volume of air in the engine crankcase, provision must be made for the engine to "breathe", that is, to draw in and expel air from the crankcase. Usually, the oil-fill pipe is used for this purpose, being provided with a cap designed to permit passage of the air. The cap is filled with metal wool or gauze which, being coated with oil at the time of installation or by passage of oil-laden crankcase vapors, acts as a fairly effective air filter.

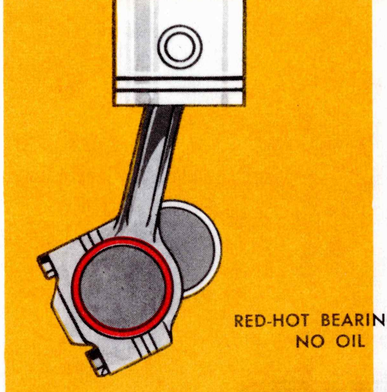
A lubricating oil filter may or may not be part of the regular equipment installed on the engine when it is delivered. Usually, where a filter is not supplied, provision is made so that one can be readily attached. Oil filters for automotive use may be grouped in two general types—the replaceable-element type where the filter body or shell is retained and the element is replaced after a certain period of service; and the non-replaceable element type where the entire unit must be replaced. There are, of course, different designs of each type.

Filters are also classed as "full-flow" or as "by-pass", with reference to the method of installation. In the full-flow type, all oil discharged by the pump must pass through the filter before it is distributed to the various points in the system. In the by-pass type, only a portion of the oil passes through the filter, the remainder going directly to the points to be lubricated.

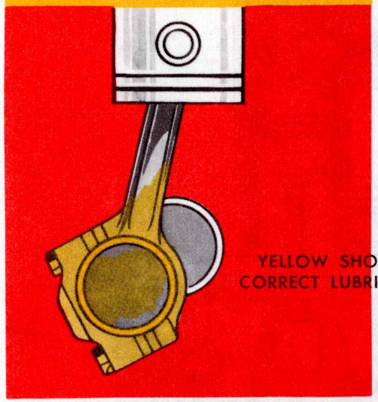
The principal objective of the filter is to remove from the oil those solids, such as road dirt, casting sand, metallic particles and relatively large carbon particles, which are abrasive and cause wear or which may plug oil passages and thereby deprive moving parts of sufficient oil for lubrication. A properly maintained filter helps to lengthen both engine and lubricant life by the removal of these harmful contaminants.



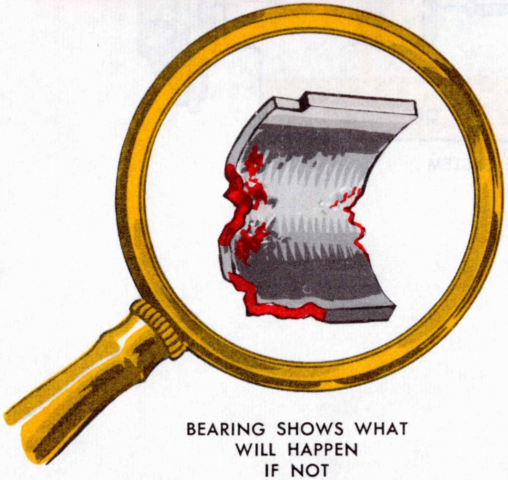
FULL PRESSURE SYSTEM



RED-HOT BEARING –
NO OIL



YELLOW SHOWING
CORRECT LUBRICATION



BEARING SHOWS WHAT
WILL HAPPEN
IF NOT
LUBRICATED

What the oil must do

Look at any bearing surface and it appears as smooth as glass. Feel it and it couldn't feel smoother. But examine it under a microscope and it will be seen to be very rough.

When two metal surfaces such as bearing surfaces are rubbed together without a film of oil between them, the resulting friction creates an ever-increasing amount of heat which eventually is sufficient to cause the fusing together of the two surfaces; this is what happens when bearing surfaces "seize up".

Firstly, therefore, lubricating oil must provide a slippery film between the two moving surfaces, a film which will withstand great pressures, and sometimes heat, and still keep the moving surfaces apart, preventing metal to metal contact. Friction decreases the efficiency of your car.

Pistons are made of aluminium alloy because it is lighter and conducts heat better than cast iron. The alloy expands and contracts more than iron and therefore the pistons do not fit tightly in the iron cylinders when the engine is cold. However, the iron piston rings do fit tightly and they prevent the compressed gases from escaping past the piston.

Any escape is called "blow-by" and causes loss of power and the "pumping" of oil past the piston into the combustion chamber — a wasteful condition. This can also happen when the cylinders, pistons and rings wear after much use and can be detected (apart from loss of power, which could be due to other causes) by a continuous issue of blue smoke from the exhaust pipe.

Oil must therefore as well as reducing friction seal the piston rings to prevent "blow-by" and power loss. "Blow-by" also can cause contamination of the crankcase oil with unburnt and partly burnt fuel (crankcase oil dilution).

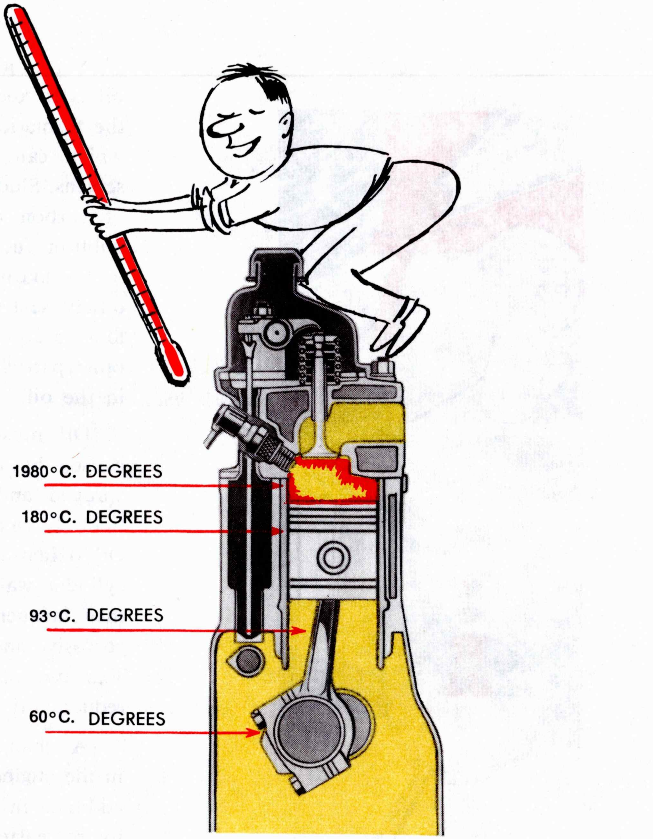
Oil has the job, also, of rapidly transferring heat away from pistons, big ends, main bearings and other moving parts, through to the metal of the engine block and thus to the cooling water. The circulating oil carries heat to the crankcase sump, where it is cooled by the air-flow over the outside of the sump.

So it is seen lubricating oil must maintain viscosity or "body" at high operating temperatures to cushion all loads on bearings and other rubbing surfaces and prevent metal-to-metal contact and wear; equally important, it must remain fluid at low temperatures to promote easy starting and circulate rapidly to all parts as the engine is warmed up, giving instant lubrication and protection.

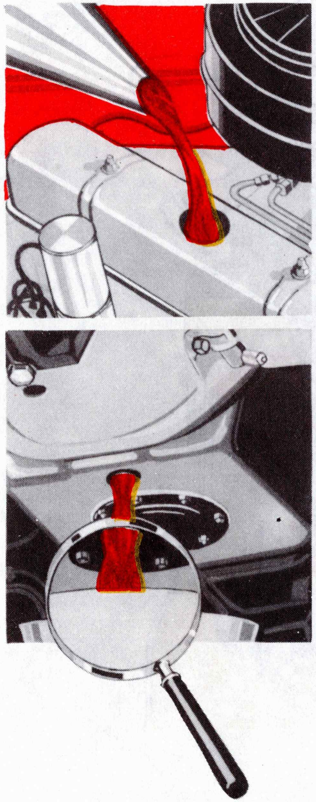
When the engine is warm its temperature varies at different points from 60°C. to over 540°C. The cylinder wall temperatures may reach 180°C. Compare this with the boiling point of water, 100°C.

Modern cars, because of their high compression engines, are very sensitive to the presence of carbon in the combustion chamber. The already high compression is raised by the presence of carbon, and the insulating effect in the combustion chamber further increases temperatures and pressures.

To keep carbon formation to an absolute minimum the use of a modern multi-grade oil such as Mobiloil Special is essential.



Why oil must be changed



Yet another function of a good lubricating oil is to keep the engine clean and to prevent the formation of harmful deposits and sludges which can block oil ways and clog pump-screens. Sludges are formed by minute particles of carbon combining with road-dust, water, unburnt fuel, grit and other contaminants in the crankcase. Detergent additives keep these otherwise harmful deposits encased by a thin film, preventing them from coagulating with other particles, and in harmless free suspension in the oil.

Oil must also resist oxidation, which is caused by the air oxidising the oil as it is sprayed and churned in the crankcase, particularly when operating temperatures are high. Oil oxidation occurs in the crankcase and on cylinder walls, resulting in formation of acid, then lacquers and sludge. The acids are very corrosive and many attack the engine bearings. The use of oxidation inhibitors in the oil reduces oil oxidation.

A change comes over the lubricating oil in the engine during the miles of running. The additives in the oil gradually become exhausted by increasing contamination. When this happens the oil loses all its neutralizing effect and is not able to hold in suspension an ever-increasing amount of deposit forming material. Dilution by unburnt petrol will rob the oil of body.

The oil becomes lifeless, black, gritty, and unsafe for the engine . . . the next time you have your oil changed ask your garageman to show you what he has drained off, or look at the filter element. Notice the difference between it and clean, fresh oil.

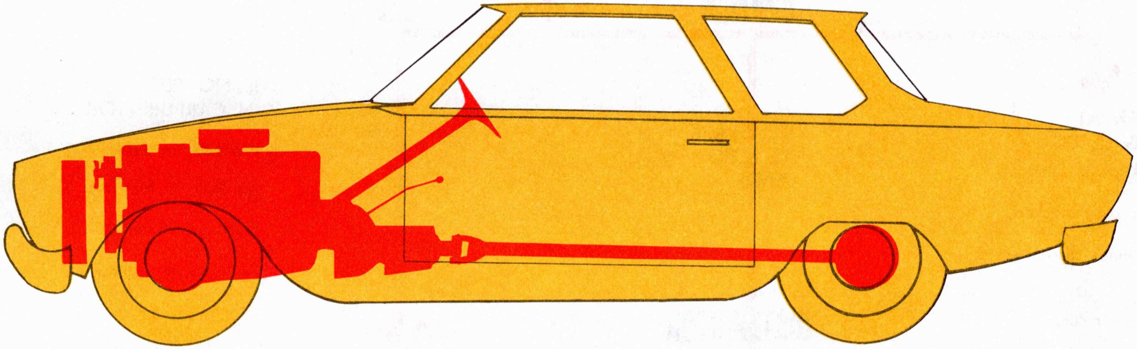
The extended use of contaminated oil will cause trouble of many kinds. Regular draining at intervals determined by the type of driving conditions that prevail should be considered low-cost insurance against impaired performance and shortened engine life.

Tests have shown that the best results and least wear are obtained by draining the old oil and replacing with new clean oil at regular intervals. The more severe the operating conditions the more frequently this should be done.

Since the majority of passenger cars are operated under the unfavourable conditions of stop-start city driving, regular change of oil, at least every 90 days, is necessary.

Points to remember

Your car must be well lubricated at all oiling and greasing points to enable it to function as an efficient machine. Your car instruction book and your Mobil service man will tell you when these points must be serviced.



ENGINE.

1. Sump.
2. Distributor.
3. Generator.
4. Throttle linkage.
5. Water pump.
6. Starter.
7. Oil filter check.
8. Air cleaner.

FRONT END.

1. Suspension arms.
2. Shock absorbers.
3. Steering arms.
4. Steering box.
5. Front wheel bearings.

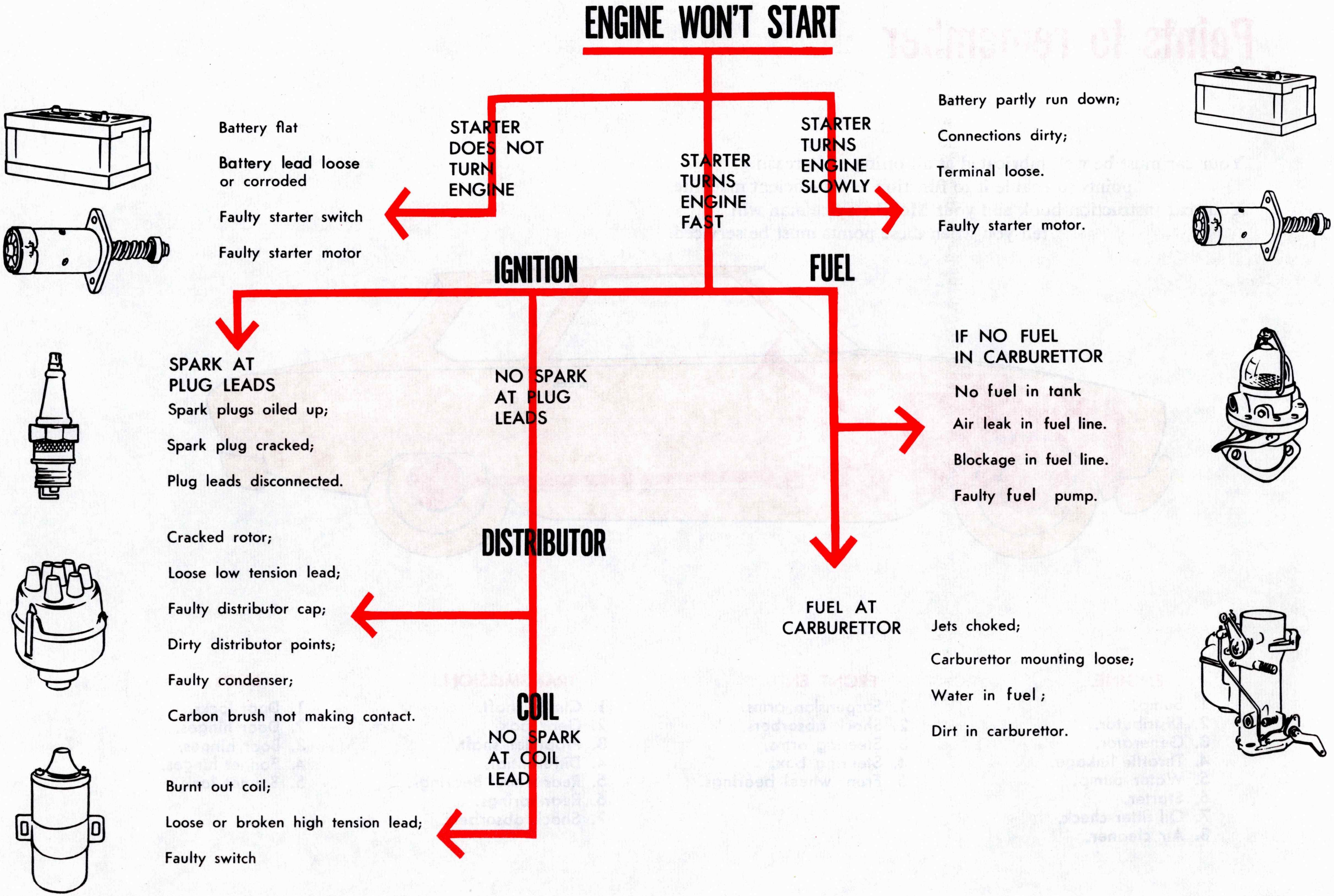
TRANSMISSION.

1. Clutch shaft.
2. Gear box.
3. Propeller shaft.
4. Differential.
5. Rear wheel bearings.
6. Rear springs.
7. Shock absorbers.

BODY

1. Door locks.
2. Door hinges.
3. Boot hinges.
4. Bonnet hinges.
5. Bonnet lock.

Trouble-tracing chart



ENGINE WON'T START

STARTER DOES NOT TURN ENGINE

- Battery flat
- Battery lead loose or corroded
- Faulty starter switch
- Faulty starter motor

STARTER TURNS ENGINE FAST

STARTER TURNS ENGINE SLOWLY

- Battery partly run down;
- Connections dirty;
- Terminal loose.
- Faulty starter motor.

IGNITION

SPARK AT PLUG LEADS

- Spark plugs oiled up;
- Spark plug cracked;
- Plug leads disconnected.

NO SPARK AT PLUG LEADS

DISTRIBUTOR

- Cracked rotor;
- Loose low tension lead;
- Faulty distributor cap;
- Dirty distributor points;
- Faulty condenser;
- Carbon brush not making contact.

COIL

NO SPARK AT COIL LEAD

- Burnt out coil;
- Loose or broken high tension lead;
- Faulty switch

FUEL

IF NO FUEL IN CARBURETTOR

- No fuel in tank
- Air leak in fuel line.
- Blockage in fuel line.
- Faulty fuel pump.

FUEL AT CARBURETTOR

- Jets choked;
- Carburettor mounting loose;
- Water in fuel ;
- Dirt in carburettor.

ENGINE MISFIRES

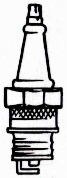
High tension leads shorting;

Incorrect spark plug gap;

Cracked spark plug porcelain;

Battery connections loose;

Electrical lead damp.



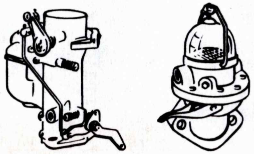
Water in carburettor

Fuel line partly blocked;

Faulty fuel pump;

Fuel pump filter choked;

Needle valve faulty or dirty.



Sticking valve;

Broken valve spring;

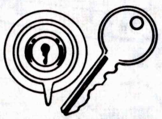
Incorrect valve clearance.

ENGINE STARTS AND STOPS

Low tension connection loose;

Faulty switch contact;

Dirty contact points.



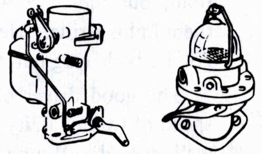
Fuel line blocked;

Water in fuel;

Needle valve sticking;

Fuel pump faulty;

Air leaks.

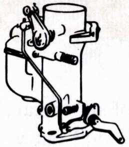


ENGINE SLUGGISH

Fuel feed faulty;

Ignition timing incorrect;

Carburettor incorrectly adjusted.



Valve sticking;

Valve burnt or broken;

Valve spring broken.

ENGINE DOES NOT GIVE FULL POWER

Ignition retarded;

High tension lead shorting;

Faulty distributor cap;

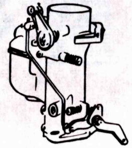
Faulty plug.

Valve burnt or bad seating;

Incorrect valve clearance;

Fuel supply faulty;

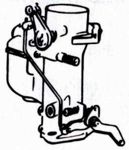
Jets partly choked.



ENGINE RUNS ON WIDE THROTTLE ONLY

Slow running jet blocked:

Carburettor flooding.



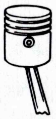
ENGINE KNOCKS

Standard instead of Super fuel

Timing over advanced.

Excessive carbon.

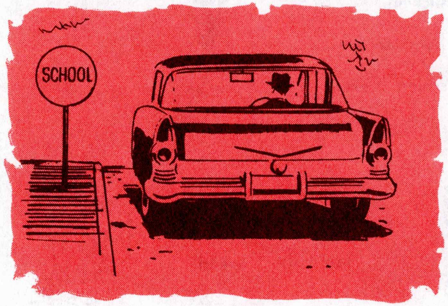
Worn bearing or pistons.



Good driving

City traffic is a test of good driving. The average city mile requires as many driving decisions as many miles of driving on the open road, but the alert and skilful driver takes them in his stride. Here are some pointers on good city-driving habits.

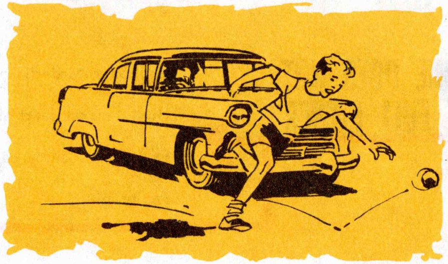
The good driver conforms to the general speed of traffic. City speed limits are usually well posted. Watch for special situations, such as school crossings, hospital zones, and the like.

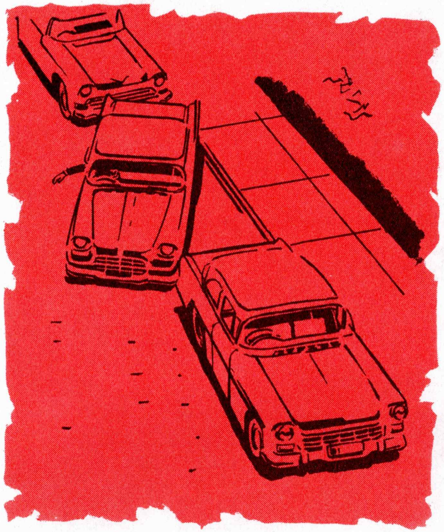


When preparing to turn, move into the appropriate lane well ahead of time, and signal your turn. Never turn from the wrong lane, cutting in front of other cars — that's inviting trouble. Don't pull out wide before turning. Slow down instead, so you can make the turn from your own lane. Watch for pedestrians at all times !

Always slow down at intersections. Your view may be obstructed and the number of dangerous possibilities greatly increased. When you stop at an intersection, don't block the crosswalk, forcing pedestrians to detour around you and into the traffic stream.

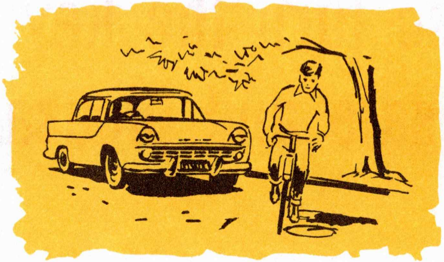
Parking regulations vary widely in different communities. Don't park in front of hydrants, driveways, or the entrances to theatres, schools, or other public buildings. Never double-park. At best you're blocking the parked cars, as well as general traffic. At worst, you're forcing other drivers to take dangerous chances. When leaving your parked car, don't step out into the street. Use the door on the kerb side. When driving along a line of parked cars, watch for the telltale opening door. It may be a sign of an accident in the making. When you pull out of a parking space, make sure you're safe from oncoming traffic — and be sure to signal.





"Weaving" from lane to lane is a bad practice. "The weaver" interferes with the flow of traffic and creates accident situations. He gains very little for himself in terms of time or distance. If you're going some distance, stay in the right lane except to pass.

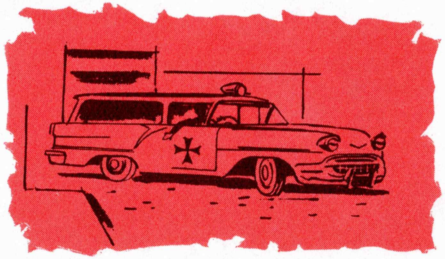
Watch for the jay-walking pedestrian. He frequently steps out from between parked cars. Sometimes you can spot this offender as he starts across the footpath. Don't expect the pedestrian to understand your problems. If he gives it any thought at all, he assumes that you can stop on a sixpence. Play smart — give him the right of way.



Children, afoot or on bicycles, are often impulsive or forgetful. When you see them playing on the footpath, slow down and be alert — they may suddenly run out in front of you. Use the same caution when passing schools and playgrounds.

Trams and buses make frequent stops. Be ready for them. If there is no safety or loading zone indicated, you must stop behind a standing tram. Keep alert when driving alongside or behind taxicabs. They may suddenly stop or swerve to pick up a waiting customer.

Police cars, ambulances and fire apparatus on calls have the right of way. Pull over and let them pass. Don't interfere with emergency vehicles.



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You now have the 'Inside information'. . .
so turn the key
and enjoy safe and pleasant driving

Mobil Oil New Zealand Limited

METRICATION CONVERSION TABLE

QUANTITY	IMPERIAL UNIT	METRIC UNIT	CONVERSION FACTORS (APPROXIMATE)	
			IMPERIAL TO METRIC UNITS	METRIC TO IMPERIAL UNITS
Length	inch (in)	millimetre (mm) or centimetre (cm)	1 in=25.4 mm	1 cm=0.394 in
	foot (ft)	centimetre or metre (m)	1 ft=30.5 cm	1 m=3.28 ft
	yard (yd)	metre (m)	1 yd=0.914 m	1 m=1.09 yd
	furlong (fur)	metre (m) or kilometre (km)	1 fur=201 m	1 km=4.97 fur
	mile	kilometre (km)	1 mile=1.61 km	1 km=0.621 mile
Area	square inch (in^2)	square centimetre (cm^2)	1 in^2=6.45 cm^2	1 cm^2=0.155 in^2
	square foot (ft^2)	square centimetre (cm^2) or square metre (m^2)	1 ft^2=929 cm^2	1 m^2=10.8 ft^2
	square yard (yd^2)	square metre (m^2)	1 yd^2=0.836 m^2	1 m^2=1.20 yd^2
	perch (p)	square metre (m^2)	1 p=25.3 m^2	1 m^2=0.0395 p
	rood (rd)	hectare (ha)	1 rd=0.101 ha	1 ha=9.88 rd
	acre (ac)	hectare (ha)	1 ac=0.405 ha	1 ha=2.47 ac
	square mile	square kilometre (km^2)	1 square mile=2.59 km^2	1 km^2=0.386 square mile
Volume	cubic inch (in^3)	cubic centimetre (cm^3)	1 in^3=16.4 cm^3	1 cm^3=0.0610 in^3
	cubic foot (ft^3)	cubic metre (m^3)	1 ft^3=0.0283 m^3	1 m^3=35.3 ft^3
	cubic yard (yd^3)	cubic metre (m^3)	1 yd^3=0.765 m^3	1 m^3=1.31 yd^3
	bushel (bus)	cubic metre (m^3)	1 bus=0.0364 m^3	1 m^3=27.5 bus
Volume (fluids)	fluid ounce (fl oz)	millilitre (ml)	1 fl oz=28.4 ml	1 ml=0.0352 fl oz
	pint (pt)	millilitre (ml) of litre *(l)*	1 pt=568 ml	1 litre=1.76 pt
	gallon (gal)	litre *(l)* or cubic metre (m^3)	1 gal=4.55 litre	1 m^3=220 gal
	acre foot	cubic metre (m^3) or megalitre (Ml)	1 acre foot=1230 m^3 =1.23 Ml	1 Ml=0.811 acre foot
Mass	ounce (oz)	gram (g)	1 oz=28.3 g	1 g=0.0353 oz
	pound (lb)	gram (g) or kilogram (kg)	1 lb=454 g	1 kg=2.20 lb
	stone	kilogram (kg)	1 stone=6.35 kg	1 kg=0.157 stone
	ton	tonne (t)	1 ton=1.02 t	1 t=0.984 ton
Velocity	mile per hour (mph)	kilometre per hour (km/h)	1 mph=1.61 km/h	1 km/h=0.621 mph
Pressure	pound per square inch (psi)	kilopascal (kPa)	1 psi=6.89 kPa	1 kPa=0.145 psi
	atmosphere (atm)	kilopascal (kPa) or megapascal (MPa)	1 atm=101 kPa	1 MPa=9.87 atm
	ton per square inch (ton/in^2)	megapascal (MPa)	1 ton/in^2 =15.4 MPa	1 MPa=0.0647 ton/in^2
Temperature	degree Fahrenheit (°F)	degree Celsius (°C)	$°C=\frac{5}{9}(°F-32)$	$°F=\frac{9 \times °C}{5}+32$

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